MACHINERY.

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AMONG THE SHOPS.

THE NEW WORKS OF THE BECKER-BRAINARD MILLING MACHINE COMPANY.

The tendency among machine tool builders at the present time is toward specialization. The possibilities of development with any one kind of machine tool are so great that most firms concentrate their energies upon one line, or at least a few lines, and try to adapt their machines to as wide a range of work as possible. The Becker-Brainard Milling Machine Co., Hyde Park, Mass., have followed this policy with marked success and have one of the largest plants in the country devoted exclusively to the production of a single line of tools. Milling machines and gear cutters, which latter are but a type of milling machine, are their only products, and it is interesting to note that they are one of the oldest firms to devote their attention solely to one kind of machine.

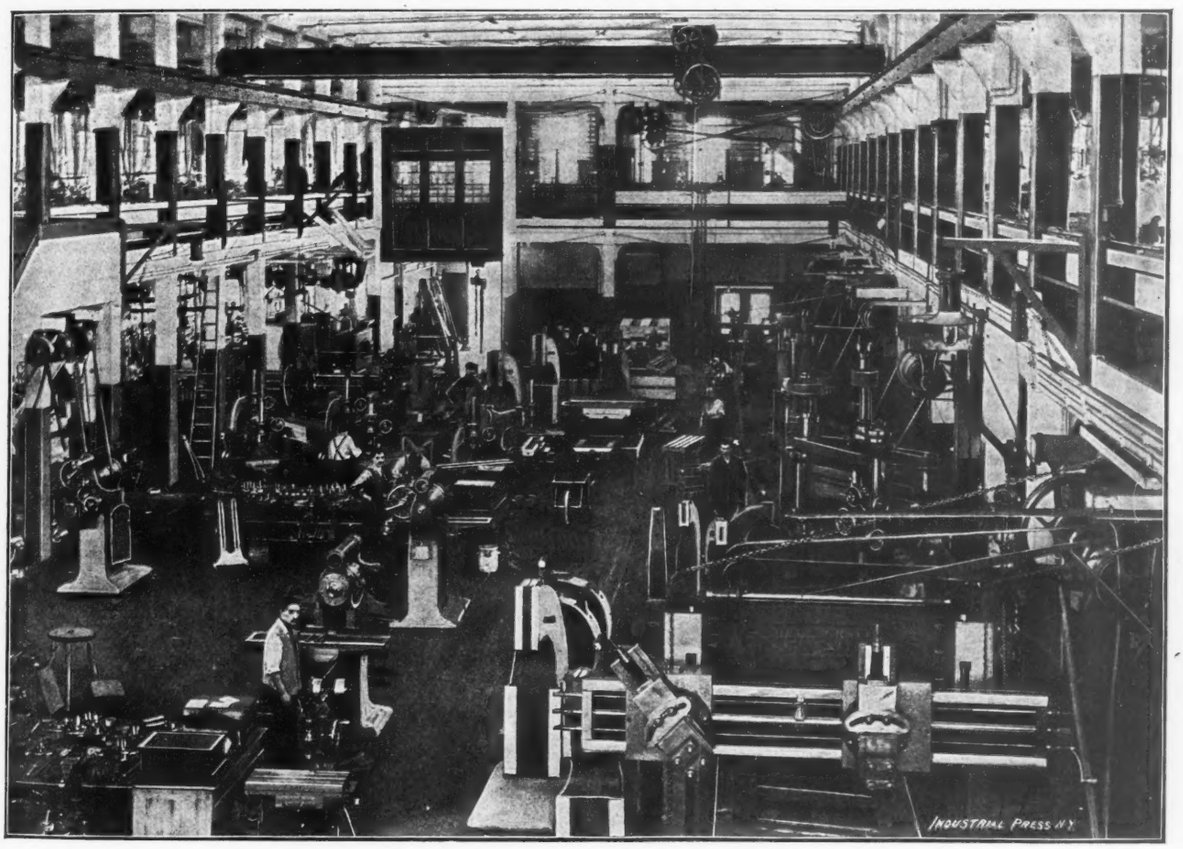

Fig. 1. Main Floor of Machine Shop Looking Toward the Front.

The Brainard Milling Machine Co. was organized in 1871 for the purpose of manufacturing milling machines, by Amos H. Brainard, a pioneer in the manufacture of such machinery, and horizontal machines were built exclusively. In 1899 the Brainard works were almost completely destroyed by fire, only one or two buildings remaining. The erection of new buildings was at once begun and the completed plant is modern in all its appointments and equipped throughout with new tools. In 1899, also the business of the John Becker Manufacturing Co., Fitchburg, Mass., manufacturers of the well-known vertical milling machine designed by John Becker, was brought to Hyde Park and consolidated with the Brainard Milling Machine Co. under the firm name of the Becker-Brainard Milling Machine Co. The machines now manufactured, therefore, include both the horizontal and vertical types, and about 400 employees are engaged in their production.

Most of the buildings are constructed of wood, sheathed on the outside with metal, as shown in Fig. 3, which is a view of one wing of the machine shop. The window space is exceptionally large, the buildings being lighted both from the sides and from overhead. The interiors are painted white throughout, making the rooms light, clean and pleasing in effect. The general construction of the machine shop is indicated in the views of the main floor in Figs. 1 and 4, which show the massive wooden columns supporting the galleries and roof, the arrangement of the tools, the crane, etc. The shops are lighted by electricity and power is transmitted to the different departments electrically from the power plant of Sturtevant engines and generators shown in Fig. 10. They are heated by the Sturtevant hot blast system.

In any manufacturing plant it is desirable to have the buildings so located that the supplies can be easily unloaded where wanted, and that the parts of the machines being manufactured will pass from one building to another during their production without having to be carried back over ground that they have previously traveled. It is also desirable to have convenient facilities for shipping. These three conditions appear to be carried out in a very nearly perfect manner in this plant, and the plan in Fig. 2, which shows the location and arrangement of the buildings, will repay careful study.

The position of the main machine shop is indicated at the

lower edge of the map. It faces directly on the street and two wings project, one at each end of the main building. The shop, with these wings and the smaller machine shop at the center of the map—which is a brick building remaining from the Brainard plant—nearly surround a hollow square. The power plant is located at the center of the group, about equally distant from every part of the works where power is needed. Back of this group of buildings are the foundry, casting cleaning building, carpenter shop, etc. It will be noted that the pattern shop and the pattern storage buildings are near one another and are also convenient to the foundry. Freight is received and shipped at the platform beside the railroad tracks shown at the upper right-hand corner of the map. The tracks at this point are above grade and the platform is built very nearly level with them. Beneath the platform are bins for receiving foundry sand, coke and other bulky supplies, their location here making it possible to unload cars directly into the bins without hoisting or hauling. A platform runs from the shipping platform directly to the foundry cupola, passing over scales, so that the pig iron can be weighed and wheeled to the cupola without having to be hoisted or carried in wagons. Both of these platforms have car tracks. A complete system of tracks also runs from the shipping platform through the yard to the foundry, the machine shop and the boiler room. This track is below the level of the shipping platform and enters the machine shop in the basement, as indicated in Fig. 2. An elevator carries freight from the tracks in the basement to any floor in the shop; or, on the other hand, carries completed machines to the car when ready for shipment. At the shipping platform is a conveniently arranged hoist for serving the car at that point and also for loading freight cars upon the regular line of railroad. In the basement of the machine shop wing where the yard track enters, are the store rooms for small castings ready to be machined and for bar stock. Under the main shop is a store room for larger parts and finished castings, and a feature of this room is a novel arrangement of doors opening into the inner square. The sides of the basement have double sliding doors extending the whole length. The first door slides in front of the second one, the second door behind either the first or the third, and so on, there being two sets of tracks extending the whole length of the wing, enabling the doors to be opened at any point. This makes it possible to load stock upon any of the racks directly from the car; or to withdraw stock from any of the racks, place it upon the car, and transport it to any part of the works without handling. This excellent arrangement of the stock room and the car track will be evident from the illustration, Fig. 3.

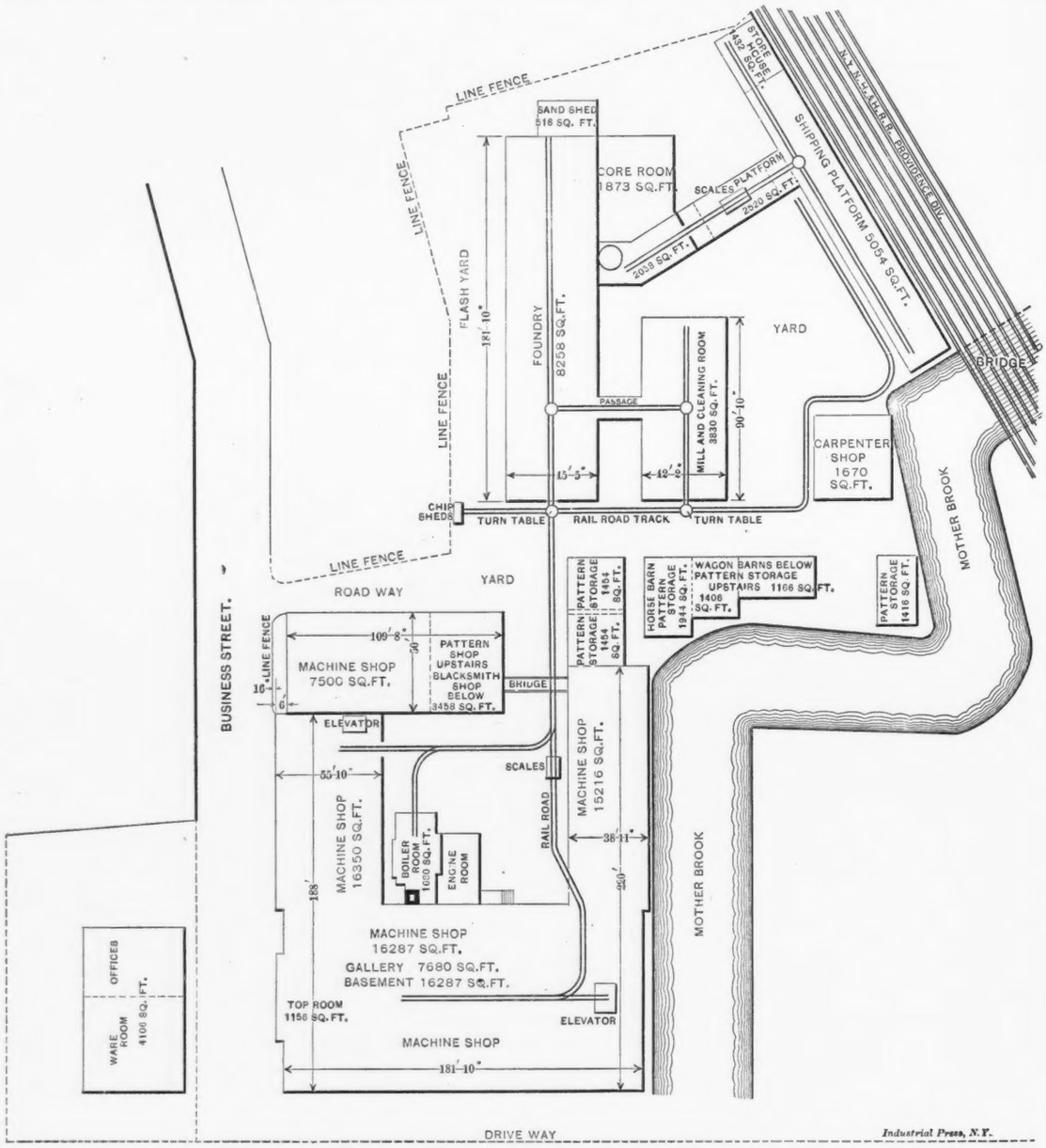

Fig. 2. Ground Plan of the Works of the Becker-Brainard Milling Machine Co.

As will be evident from the views in Figs. 1 and 4, the main floor of the shop is used for erecting, and some of the heav-

ier machine tools are located at the sides. Under one of the galleries is the vertical milling machine department shown in Fig. 7 of the group, where are located twelve machines of this

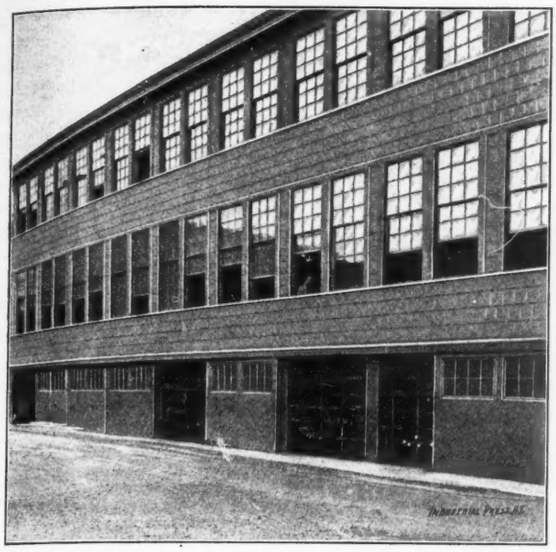

Fig. 3. Exterior of Machine Shop Wing showing Arrangement of Store Room Doors.

type. The various kinds of work for which they are adapted have already been fully illustrated in these columns and may be judged somewhat by the group of cutters shown in Fig. 5. This is the equipment that is regularly manufactured for the No. 6 vertical milling machine, and similar equipments are made for the other sizes, while the same cutters can also be used in several sizes of machines. The large surfacing mill shown with inserted teeth is 14 inches in diameter and of simple construction. Slots are milled at an angle in the periphery of the rim for cutters of square steel, and saw cuts are made in the rim between the cutters and forced open by taper pins, thus clamping the cutters.

It will be noticed that many of the group of cutters illustrated are either beveled or formed cutters, and thus can produce beveled or curved edges on either the interior or exterior of the pieces operated upon. A class of work that cannot be produced easily in any other way can thus be done on the vertical milling machine. This applies to circular as well as to straight work when a circular milling attachment is provided.

A view of a section of the main floor appears in Fig. 6, which shows several of the new No. 7 vertical milling machines that are now being brought out. This is the largest vertical machine yet produced by this company and weighs when complete about ten tons. The spindle is 4¼ inches in diameter and is driven by a 5½-inch belt. As indicating the capacity of this machine, it is stated that it is sufficient to

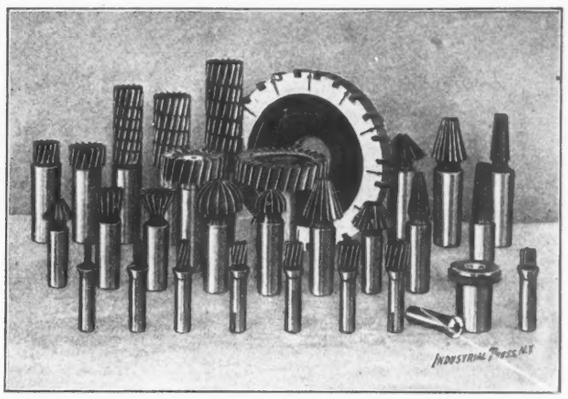

Fig. 5. Set of Cutters for No. 6 Vertical Milling Machine.

finish any of the parts of the smaller sizes of the horizontal machines upon it that would ordinarily be done by planing or milling.

Several new and improved designs of horizontal machines have also recently been brought out, one of which—the 5 B machine—has been illustrated in these columns. A feature noted is the adoption of a long saddle for the support of the table, the saddle and table being of the same length, which

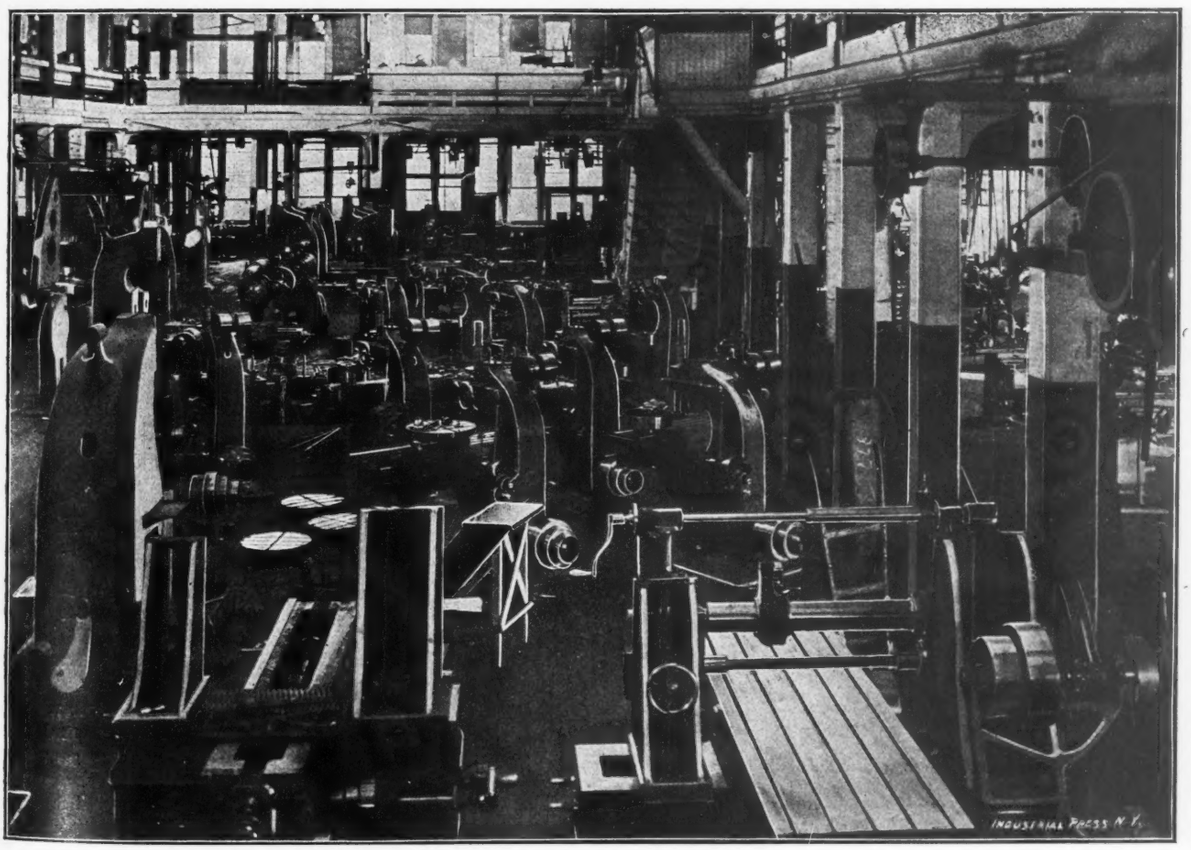

Fig. 4. Main Floor, looking towards the Rear. Two Large Slab Milling Machines in the Foreground.

gives the table firm support, even when it is run out to the extent of its feed.

While the milling machine plays an important part in the manufacture of its own kind in these works, and is extensively used in many processes for the reproduction of its kind, it is not used to the exclusion of the planer when the latter can be employed to better advantage. The custom is not followed of using one's own machines to the exclusion of other types, even if at a disadvantage, in order to impress prospective customers. A view of the planer department is shown in Fig. 8 and there are in all about 24 planers used in the works. The machines are arranged with every alternate one pointing in the same direction and the other machines pointing in the opposite direction. This makes it easier for one operator to look after two machines when they are running on long cuts.

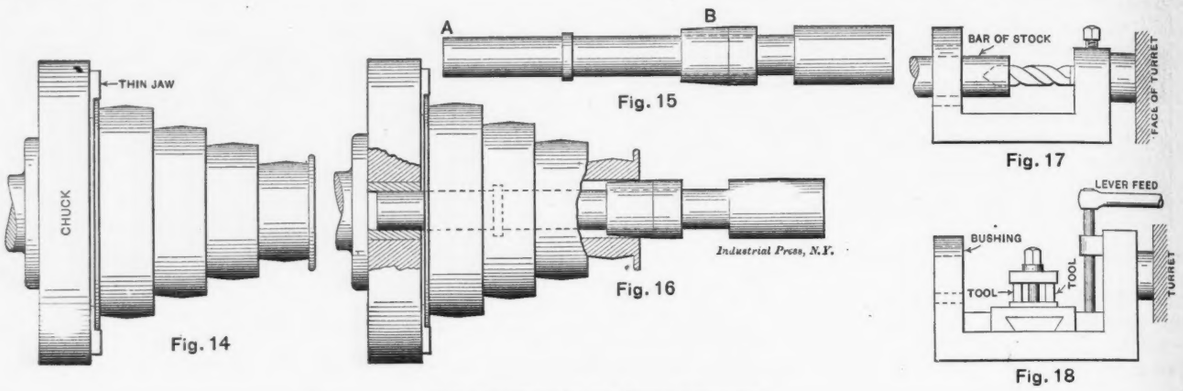

Fig. 14 Fig. 15 Fig. 16 Fig. 17 Fig. 18

Group of Chucking and Turning Fixtures.

The practice is adopted of setting up as many similar pieces as possible to be operated upon at one time. For example, a line of milling machine knees would be set up so that the dove tail slides of all of them could be planed at once, suitable jigs being designed to properly locate the knees and produce duplicate work. On one planer we noticed a "set up" that is particularly worthy of attention. A series of rectangular cast-iron boxes or knees were ranged longitudinally on the planer table and tongued to the central slot. The tops and sides of these boxes were planed true and provided with T-slots to which work could be bolted. In this instance several milling machine tables and saddles had been fitted together and these were bolted in pairs on each side of the rectangular boxes or knees and the edges of both tables and saddles were being planed at once, both planer heads being used.

In the chucking department, where are located the turret machines, several novel methods are to be seen. In turning the cones for the horizontal milling machines accurate work is necessary and the product must be in much better balance than is required for countershaft cones. These were formerly turned on the engine lathe because it was believed that turret lathe methods were not accurate enough for the requirements. The simple method shown in Figs. 14 to 16, inclusive, was devised, however, and now these cones are regularly made on a Gisholt turret lathe in a very satisfactory manner and at a large saving in expense. These cones have flanges at each end, as indicated in Fig. 14. Special jaws were made for the lathe chuck, which project only a short distance from the face of the chuck. For the first operation the cone is held in the chuck with the small end projecting and the hole is rough bored to within about 1-16 of an inch of finished size. The chuck jaws are not depended upon to drive the cone, as this would necessitate very tight clamping, which would be likely to spring the cone. A projection from the face of the chuck is used as a driver.

The second operation is to rough-turn the cone, but as the chuck jaws would not be sufficiently rigid to support it a steadying bar, shown in Fig. 15, is used. The end *A* of this bar is turned to fit a bushing driven in the opening at the center of the chuck, and at *B* is a bushing that is free to slide or turn upon the bar. This bushing is tapered for two-thirds of its length and then for a short distance the large end is turned to the same diameter that the hole in the cone is to be bored when finished. For the second operation of turning, the bar is passed through the rough-bored hole in the cone until the small end has a bearing in the bushing at the center of the chuck. The outer end of the bar may be supported by one of the holes in the turret of the lathe or by a center inserted in place of one of the turret tools. The taper bushing upon the bar is then slid along until it has a firm bearing in the hole at the outer edge of the cone, as indicated in Fig. 16. Thus supported, the cone can be roughed out, and for this purpose the turret tool post using four tools—one for each step of the cone—is employed. After roughing out the cone, the bar is withdrawn and the hole is finished to size. The bar is again replaced and the bushing is slid into the finished hole, the bearing this time being upon the cylindrical or straight portion of the bushing, which is the exact size of the finished hole. The turning of the cone is then finished. All that remains to be done now is to face the flanges, which is done by reversing the cone and holding the small flange in the chuck, the bar being used as before.

In Figs. 17 and 18 fixtures are shown for doing accurate work in the Gisholt lathe upon large bars of round stock, a purpose for which the lathe was not designed and for which no attachments are provided. A bar several feet long is held and driven by the chuck of the machine, and a box tool, like that in Fig. 17, inserted in one of the holes of the turret. A bushing in the outer end of the fixture supports the outer end of the bar, while the drill shown can be used for drilling a hole in the end of the bar as accurately as though only a short length of the bar were projecting from the chuck. In Fig. 18 is a similar device with a cross slide operated by a lever feed. A double tool post carries two turning or forming tools,

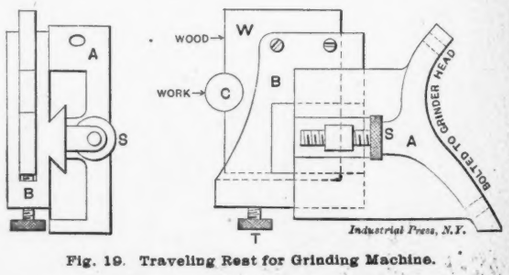

Fig. 19. Traveling Rest for Grinding Machine.

or cutting-off tools, as desired, which operate on the end of the bar while the latter is rigidly supported by the bushing inserted in the outer end of the fixture.

The grinding department is equipped with universal and plain grinding machines and a great deal of work is finished by abrasive processes. A kink was shown the writer, in this department, that is used successfully in grinding spindles and shafts that need to be supported by back rests, to prevent deflection under the pressure of the wheel. Two types of back rests are used on grinding machines, one of which travels back and forth with the wheel, always supporting the work at a point opposite that at which the wheel is cutting. The other type is stationary, and back rests must generally be placed at short intervals to insure the best results. The tendency of a back rest that travels with the wheel is to crowd the work toward the wheel whenever it comes against any high spots in the piece being ground. To obviate this a device

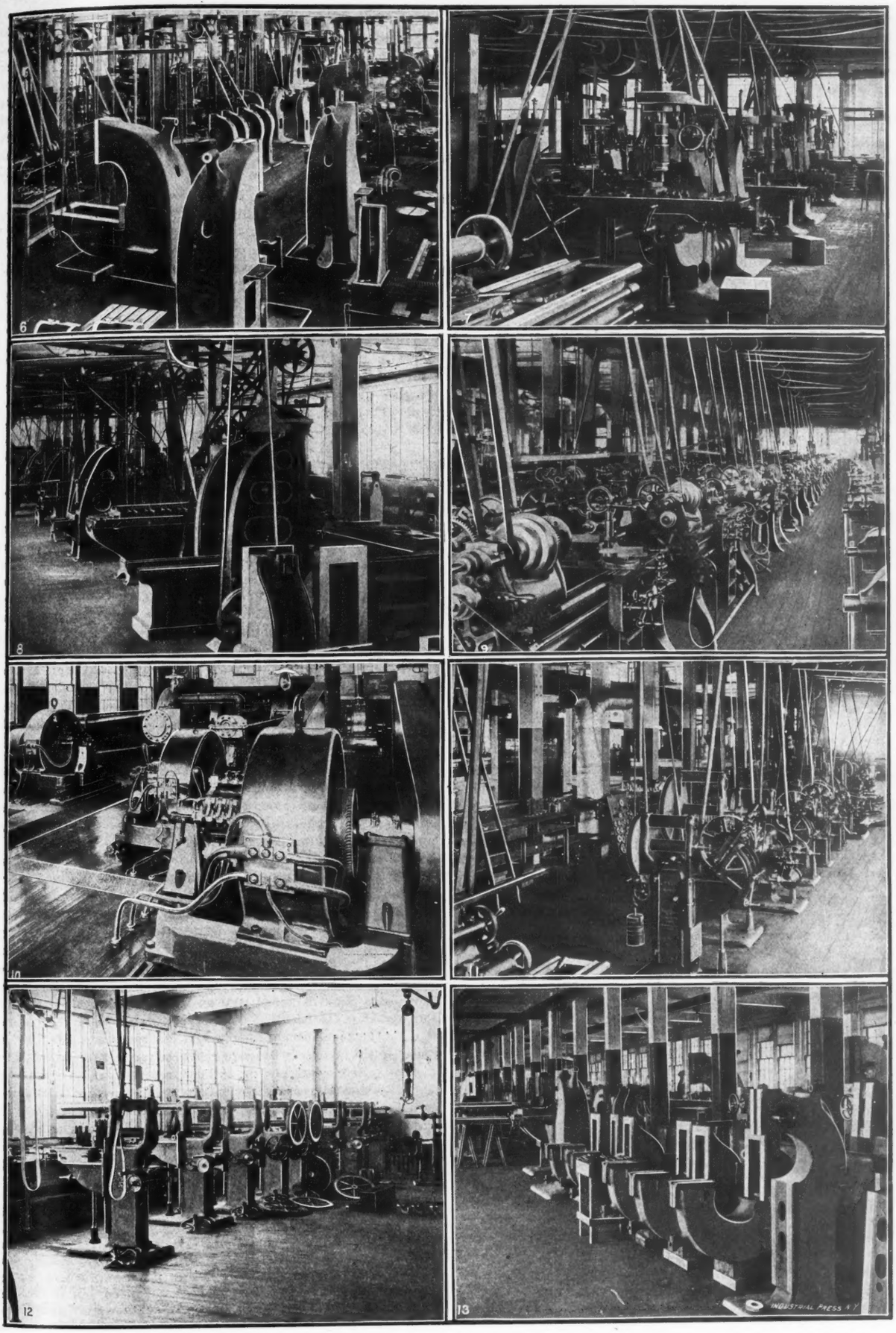

Fig. 6. Largest size Vertical Machines in Process of Erection. Weight, ten tons each.

Fig. 7. Corner of Milling Department with twelve Vertical Machines.

Fig. 8. Planer Department.

Fig. 9. One of the Galleries devoted to Lathe Work.

Fig. 10. Engine Room equipped with Sturtevant Engines and Generators.

Fig. 11. Automatic Gear Cutters. Discharge Pipes of Heating System also shown.

Fig. 12. Erecting Automatic Gear Cutters.

Fig. 13. Scraping Department.

INTERIOR VIEWS OF BECKER-BRAINARD SHOPS.

shown in principle in Fig. 19 is here used. The frame *A* is bolted to the head of the grinder beside the wheel. This frame carries a sliding piece, *B*, that can be moved out or in by the screw *S*. Piece *B* is slotted to hold a strip of hard wood, *W*. This wood is held in position by the screws shown and can be raised or lowered by the thumb screw *T*. It bears against the work *C* on the same side that the wheel operates and prevents the work being forced against the wheel by the action of the back rest.

It is found that this support wears away just about as rapidly as the emery wheel, and superior results are obtained by its use.

* * *

A BLUE-PRINT FRAME.

An ingenious blue-print frame is in use in the blue-print room connected with the drafting room of the Brown & Sharpe Mfg. Co., Providence, R. I. The frame is arranged upon wheels to run out of a window upon a track and so as to be reversed for replacing prints or tracings without requiring handling.

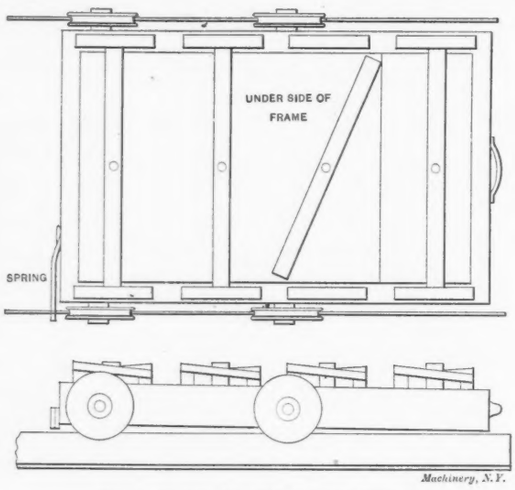

Fig. 1. Under Side of Blue-print Frame.

The frame, shown bottom side up in Fig. 1, is a large size blue-print frame constructed after the manner of an ordinary photographic printing frame, with removable boards at the back held in by spring levers, and arranged so that a small section in the back at one end can be removed to permit examination of the print without disturbing the whole. It is carried by two pairs of flanged wheels, one pair at one end

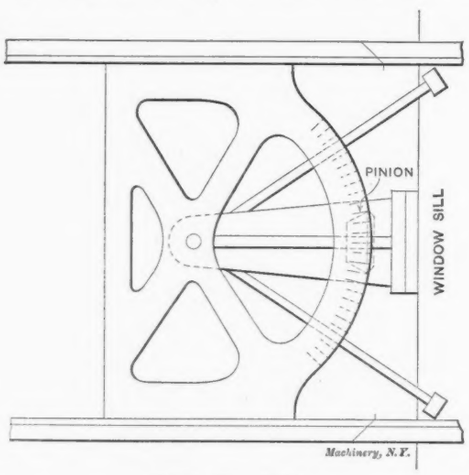

Fig. 2. Turn Table.

and the other pair near the middle. The pair near the middle is so placed that the frame is nearly balanced, and may be reversed thereupon, and thus turned either side up. The pair at the outer end will bear upon the track whichever side of the frame is up. When the frame is pulled into the blue-print room from outdoors, the middle pair of wheels drops into depressions made in the tracks, which hold the wheels in position on the tracks while the frame is swung over into the position shown in Fig. 1, for changing the print or tracing. When the print is renewed, the frame is swung back right side up and rolled on the track outside of the window for printing, and passes onto a turn table, a plan of which is shown in Fig. 2. This turn table is operated by a handwheel inside the windowsill and pinion, which meshes into a rack on the underside of the turn table, in order to point the frame in the direction necessary to get the most favorable light.

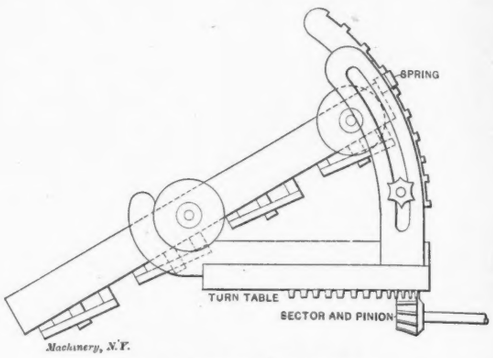

Fig. 3. Position when Printing.

In the illustration, Fig. 3, is shown the position of the frame when printing. It is pushed out onto the turn table until the middle wheels strike the stop, and then the inner end of the frame is raised to the required angle and held in that position by a flat spring on the frame which fits into notches in the sector shown at the right in Fig. 3. Further adjustment beyond that afforded by the notches may be obtained by means of the slot and clamping screw shown on the sector. The two adjustments obtained by rotating the turn table and tilting the frame, make it possible to bring the print in a plane perpendicular to the rays of the sun at any time of day, the window being a south window. On rainy days the frame can be set in a vertical position inside the blue print room, and exposure be made to the light that enters through the window.

* * *

A writer in a German publication holds that as a scale preventative there is nothing more effective and at the same less expensive and easier to use than soda. He states that it can be used successfully without analyzing the feed water and gives the following directions:

"When filling the boiler add to the water so much dissolved soda that a strip of red litmus paper is distinctly, but not too much, blued. During working add regularly so much soda that the coloring of the paper faintly continues. In order to test the water blow off a little from the gage cocks, then shut it off so that only a few drops will run out, which, if allowed to drop on the litmus paper, should show the blue color in one or two minutes. Should this not take place, then more soda must be added, and on the other hand, if the paper quickly shows a decided blue, no more soda must be put in. With a little experience it is easy to gage the quantity of soda, and it will only be required to make tests once or twice a week. Soda prevents, or at least retards, the formation of hard scale, and more sediment is found instead. Old scale is also gradually loosened, and where it has been allowed to accumulate it is well to clean the boiler, when commencing the soda treatment, every two or three weeks. If there is no incrustation, cleaning two or three times a year will be sufficient."

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There is an opportunity for readers of MACHINERY who have had experience in constructing, erecting or repairing steam engines or pumps to contribute articles upon these subjects. As most of our readers know, THE INDUSTRIAL PRESS, publishers of MACHINERY, also publish STEAM ENGINEERING, which is identical with MACHINERY in size and price, but is devoted to the power plant instead of the machine shop and is intended for engineers and power users. Stationary engineers do not often have the opportunity to learn the machinist's trade, and any contributions that will help an engineer to become more competent in this branch of the business will be gladly received and reasonably compensated, if accepted.

THE PHILADELPHIA CITY HALL CLOCK.

Tower clocks are usually subjected to the greatest of disadvantages that clocks have to meet. They are generally exposed to all conditions of weather, with variations of temperature that not only vary the length of the pendulum, thus altering the vibration rate, but also affect the lubricants in the mechanism by gumming, etc. Also, the usual large size of their hands makes considerable power necessary to run them, and, owing to changes of wind, and to the snow and sleet, varying powers are required.

In designing the clock for the Philadelphia City Hall tower, an attempt was made to obtain a timepiece that should be accurate in spite of the hindrances previously mentioned and also of those to be met particularly in that tower, due to vibration on account of its great height of 547 feet. In order to accomplish this, the old method of driving the hands on the dials by direct mechanical connection to the clock was abandoned, and provision made whereby the dial mechanism should be actuated by pneumatic connection from a master clock, which might thus be entirely removed from the tower and subjected to the most favorable conditions. In this way it became possible to employ an astronomical clock of the maximum simplicity and thus of the greatest possible accuracy.

The astronomical master clock was placed in the lowest room in the tower, 200 feet below the dials, where the walls of the tower are 13 feet thick, thus insuring complete stability and freedom from jar, and is housed in a small room, or booth, of glass, which was so made as to be as perfectly air- and dust-tight as possible. This prevents dust accumulations, so detrimental to delicate mechanisms. The clock is mounted upon a heavy iron pedestal, weighing over 500 pounds, with a glass door for view of the pendulum, and the pedestal is provided with three leveling screws for leveling and adjusting the pendulum's swings at any time. The weights which run the clock have a separate compartment in the pedestal from the pendulum, so that the passing of the weights will not cause air currents and affect the air-friction of the pendulum. The dial mechanism is above the iron base and is inclosed in a glass casing to further provide against dust, the winding up of the weights being accomplished by a long key entered through a hole in the glass case, which hole is otherwise kept plugged. Thus the clock has double protection against dust, and especially so as the room is not allowed to be entered but once a month for winding the clock. This protection is so effectual that no dust accumulates in the clock room even in a period of six months. For further uniformity of conditions, a thermostat is provided in the clock room, which, by means of a pneumatic connection, controls an electric heater at one side of the room so as to maintain the temperature therein constant at 75 degrees F., and it does not vary more than 1 degree throughout summer and winter, so it may be seen that this astronomical clock operates under the most perfect conditions of any clock in the world.

The pneumatic device whereby the sets of hands on the four tower dials, each of which sets weighs over 500 pounds, are driven from the delicate astronomical clock, without interfering with its accuracy, is very ingenious. It consists primarily of a small valve that is alternately held open for half a minute and closed for half a minute by a cam on the second hand arbor of the astronomical clock, the cam operating the valve through a magnified leverage so as to require little power. The action of opening of this little controlling valve is to release the pressure in an equalizing diaphragm, allowing withdrawal of a system of small levers which causes the shutting of a valve leading from the compressed air supply to the cylinder of the minute hand mechanism at the dial, while the closing of the controlling valve causes an inflation of the equalizing diaphragm, forcing out the system of levers and thus opening the supply valve. The dial mechanism, of which there is one separate for each of the four dials on the tower, consists of a cylinder and diaphragm which actuates a large anchor escapement, in which the anchor pallet is driven by the cylinder and, in turn, drives the escapement wheel, contrary to the usual cycle of movements in such escapements in clock movements.

Thus it may be seen that the dial mechanism cylinders receive pressure and release once every minute, which results in the anchor pallet moving back and forth once, thus moving the minute hand over one minute on the dial. As long as the astronomical clock, which moves the controlling valve, continues to run, the hands on the dial will follow its movements with absolute fidelity, and, as the astronomical clock is capable of the most rigid accuracy under such favorable surroundings, the dials are assured of correct time indications.

For accuracy of setting the clock to correct time, as well as keeping it corrected, a telegraphic connection by direct wire with the U. S. Naval Observatory in Washington is furnished in the astronomical clock room, as well as a city telephone for communication with the local observatory. To furnish the compressed air there are provided two electrically driven air compressors in the dial room, as well as a set of three hydraulic air compressors in the basement in the engine room, which stand ready to go to work automatically the instant that anything happens to shut off the electrical compressors. The dials are the largest dials in the world, being 25 feet in diameter. They are illuminated at night, each dial being abundantly provided with 150 incandescent lamps, and the lighting current is turned on in the evening and off in the morning by automatic machinery at the proper times. A new departure was attempted upon the dials by the omission of the usual numerals designating the hours. The usual numerals are replaced by simple heavy black bars, the hands being made very large and prominent so as to be of more value by position, and at the great height the change is hardly noticeable. Since the completion of the system there have been very few derangements, on account of nearly every part being arranged in duplicate, so that almost no combination of accidents can serve to stop the dials.

For further particulars in reference to this very interesting system, reference may be had to the Journal of the Franklin Institute of February, 1901, from which this account was condensed.

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The experience gained in the locomotive repair shops of the D. & H. Co. at Oneonta, N. Y., is that to remain tight in service, steel center driving wheels must be forced on the axles at a much heavier pressure than cast-iron centers. Thus for an 8½-inch axle fitted in cast-iron wheel centers, a pressure of from 80 to 90 tons is ample, but the allowance for fit must be increased for steel centers, so that the pressure required to force the axles home will be about 125 tons. To obtain such a fit the difference in diameter of the axle and hole in the steel center must be from .020 to .024 inch. For cast-iron centers the normal allowance for this size of axle would be about .010 inch to give the pressure quoted above. An allowance of .028 inch on an 8½-inch axle with a steel center requires a pressure of about 150 tons, depending on the length of the wheel seat on the axle. It has been found that steel center wheels fitted at the pressures ordinarily used for cast-iron centers speedily become loose owing to lack of elasticity of the hubs. The pressures given are with the tires off. The tires, being shrunk on afterward, of course increase the grip of the hubs on the axles.

* * *

The cubic contents of any regular solid, whether it be a sphere, cone, pyramid, truncated cone, prism, etc., may be found by adding together the square area of the two ends and four times the area of the middle section, and multiplying the sum by one-sixth the perpendicular height. Thus, in the case of a sphere, the area of each end is zero. The area of the middle section will be that of a great circle. Taking the diameter of the sphere to be one foot we have $0 + 0 + 4\ (1^2 \times .7854) \times (1\text{-}6 \times 1) = .5236$ cubic feet. In the case of a truncated cone having a perpendicular height of 10 inches, a top diameter of 5 inches and a bottom diameter of 10 inches, we have $(5^2 \times .7854) + (10^2 \times .7854) + 4\ (7\frac{1}{2}^2 \times .7854) \times (10 \times 1\text{-}6) = 458.15$ cubic inches. While this method is somewhat longer in some cases than the various rules given for each type of solid, it has the advantage of being easily remembered and saves remembering a number of confusing rules with the likelihood of applying the wrong one to a particular case. It is known as the prismoidal formula.

TURRET LATHE PRACTICE.—2.

FIXTURES ADAPTING THE FLAT TURRET LATHE TO SPECIAL WORK.

At the works of the Jones & Lamson Machine Co., Springfield, Vt., the flat turret lathe which is their chief product, is used extensively for making the various parts of the machine and the practice of this company forms a valuable object lesson of what can be done with their own tools. The flat turret lathe is designed primarily for operating on bar

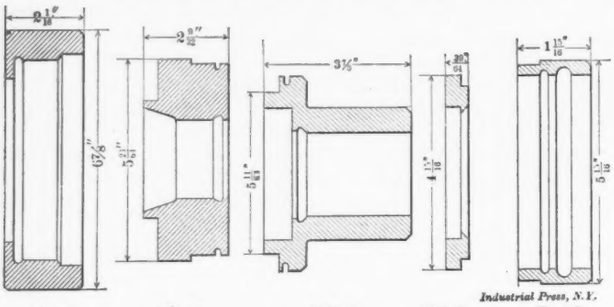

Fig. 1. Fig. 2. Fig. 3. Fig. 4. Fig. 5.

stock 2 inches or less in diameter. By the use of special fixtures, however, it can be adapted to a wide variety of chuck work, for both cast iron and steel pieces. This class of work is so interesting that we asked the superintendent of the Jones & Lamson Machine Co., Mr. E. E. Wood, to send us particulars about it for publication in a series of articles upon turret lathe practice, of which the first appeared in the May number of MACHINERY. The following sketches and photographs, with accompanying explanation, were furnished by Mr. Wood.

Turret lathes should not in mind be associated with screw machines, as there is little similarity between them outside of a revolving turret. Turret lathes are designed to do the work of the engine lathe up to two or three feet in length. which would be difficult to do in an ordinary screw machine.

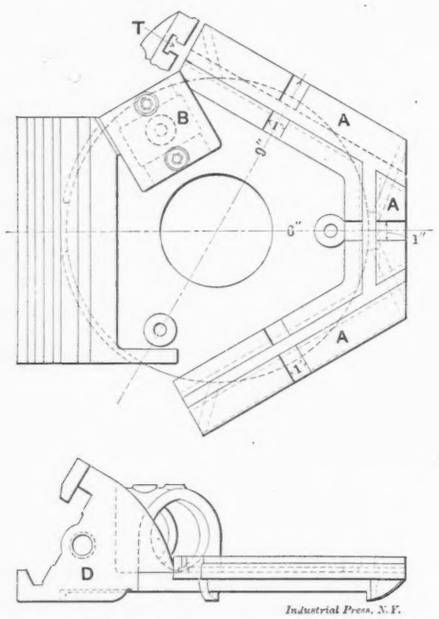

Fig. 6. Fixture for Operating on Forgings and Castings.

It has been only about a dozen years since some of the first turret lathes were placed upon the market, and, while it required considerable missionary work at first to get them established, manufacturers were soon convinced of the merits of such a machine, and to-day all progressive machine builders have from one to a dozen or more at work in their shops. These notes will be confined mainly to some of the special tools and fixtures as applied to the Hartness flat turret lathe, manufactured in Springfield, Vt.

This machine, with its equipment of tools from two inches in diameter to two or three feet in length, is so extensively used and advertised that it is needless to occupy space describing it. However, many manufacturers to-day are skeptical of the practicability of turning true round work without the aid of centers, until it is demonstrated to their satisfaction on their own work and in their own shop.

A flat turret is an ideal turret in many distinct features. One of the most prominent features is its having a large surface on which tools and fixtures can be clamped, without overhang of tools, or being cumbrous to manipulate.

This machine, with its regular equipment of tools, was designed strictly for bar work up to two inches in diameter to two or three feet or more in length, all over two feet requiring a special length of bed. By the aid of a few special fixtures, forgings of various shapes and sizes up to seven or eight inches in diameter and six or more inches in length can be finished, resulting in a nice margin of saving over the engine lathe.

Fixtures Carrying Tool Slides.

Figs. Nos. 1, 2, 3, 4, and 5 illustrate some of the work finished complete with a flat turret lathe, with an allowable variation of only a half thousandth of an inch, 0.0005 above

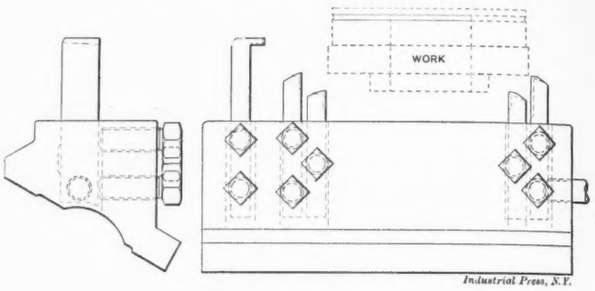

Fig. 7. Tool Slide used with Fixture in Fig. 6.

or below size or length. These pieces are cut from a bar with a cold saw, and are rough chucked before being brought to the machine to be finished.

Fig. 6 represents the style of fixture employed for these pieces. It consists of a flat cast-iron plate, on three sides of which are the ways *A A A* having a T-slot to which tool blocks with turning tools for outside diameters are clamped. Also if desired a drill or reamer holder can be clamped to the same ways, making it possible to drill and turn the outside of a piece at the same time, except such part as is held by

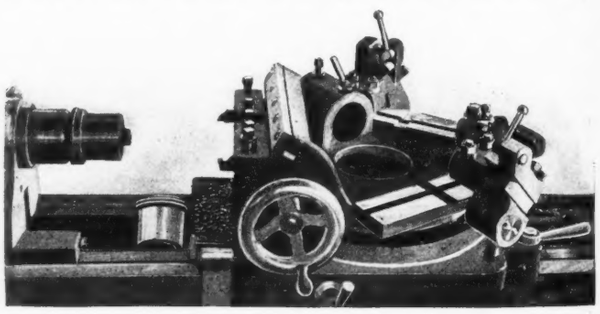

Fig. 8. View of Fixture shown in Fig. 6.

the chuck. On the opposite side of the plate is an inclined way *D* in which cross slides may be used that may be designed to be operated either by a handwheel or a lever. In Fig. 7 is illustrated one of these slides, with its equipment of turning tools, and the dotted lines in the engraving represent the comparative size and shape of the work that is to be operated upon. The exact dimensions of this piece are given in Fig. 2.

This flat plate, with its complement of tools, is simply clamped to the top of the flat turret and can be removed with all tools set and put away until required again.

Fig. 8 is from a photograph of one of these equipments actually in use on a machine, the photograph having been taken while the machine was at work, making a lot of pieces like that shown on the ways of the lathe near the headstock

at the left. In Fig. 9 is a view looking down upon a lathe equipped with one of these fixtures, of slightly different design. Here the tool slide is operated by a lever and there are several independent and immovable tool holders in place of the arrangement with the T-slot shown in Fig. 7.

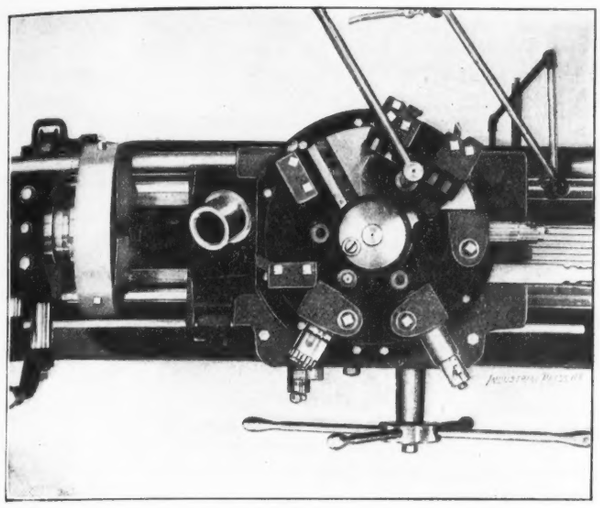

Fig. 9. Top View of Lathe Equipped with Fixture.

Such pieces as those in Figs. 1 to 5 inclusive require two operations, the first when being held with a three-jaw chuck, to finish the inside surfaces, and to square up the end. During the second operation, when the outside is being finished, the work is held with expansion or clamp chucks, like those in Figs. 10 and 11. The construction of these is evident from the sketches, the dotted lines representing the work held by the chucks.

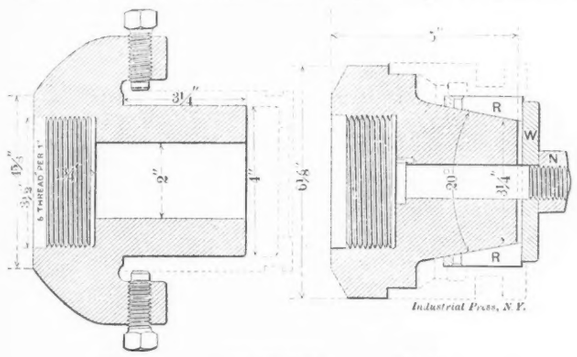

Fig. 10. Nose Chucks. Fig. 11.

In Fig. 10 the work fits over the nose of the chuck and is clamped by the setscrews. In Fig. 11 the body of the chuck is tapered and a split ring *R* tapered on the inside, with the outside surface parallel with its axis, is used for clamping the work by simply screwing the nut *N* against the washer *W*. These fixtures are generally of cast iron and are inexpensive.

Fig. 12 is a simple cross slide occupying three places on the turret and was arranged expressly for finishing the piece represented by the dotted lines. The body of the slide is bolted to the face of the turret and the slide itself, together with the tools that it carries, is operated by a handwheel. The pieces to be finished were of different lengths and an adjustable tool block is placed back of the cross slide on the base of the fixture, so that a tool could be set for turning the projecting part of the piece, regardless of the distance it might extend from the spindle of the machine. The fixture is made of cast iron, except the screws, etc. Similar slides can be arranged for facing up to 12 inches in diameter, or for double forming tools. The tool is inexpensive and the adaptability of it is obvious.

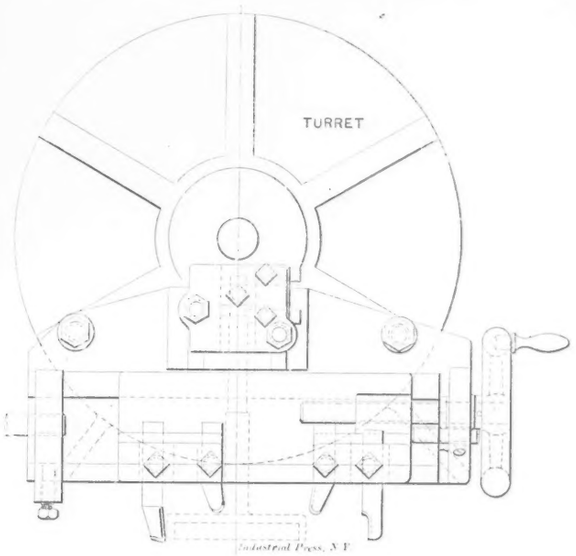

Fig. 12. Cross-slide Bolted to Turret.

Fig. 13 is a sectional view of an expansion chuck for holding the piece finished by the above cross slide. It should be noted that while the expansion bushing is drawn back in clamping the work, the piece held is prevented from moving by bearing against the body of the chuck, which latter projects beyond the expanding bushing. This definitely locates the piece with respect to the spindle and cross slide of the lathe and insures a uniform thickness of metal on each finished piece after it has been operated on by the cross slide.

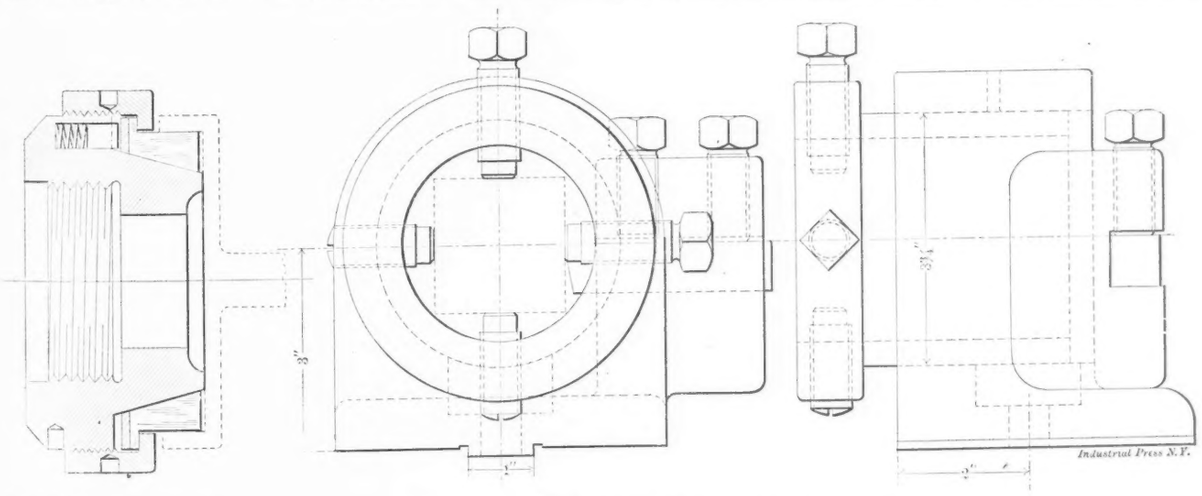

Fig. 13. Expanding Chuck. Fig. 14. Device for Starting a Cut on Square Stock.

Miscellaneous Devices.

The hole through the spindle of the flat turret lathe being only 2⅛ inches in diameter, it is impossible to pass a 2-inch square bar through it on account of the corners, but the

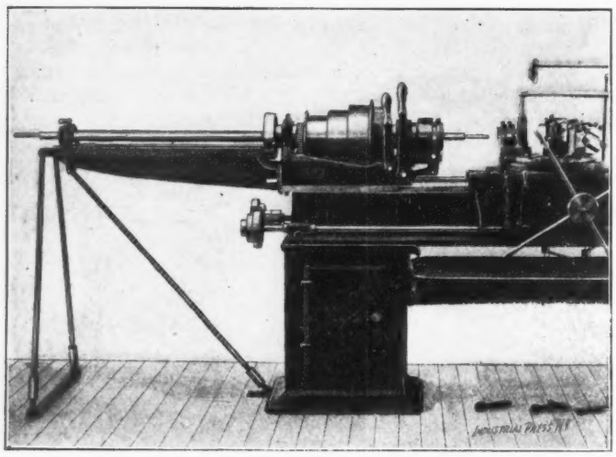

Fig. 15. Bracket for Supporting Long Stock.

pieces can be brought to the machine cut to the desired lengths, and can be held by a four-jawed chuck and turned to the desired size by the regular turners. As it is difficult to start the turners on a square piece projecting twelve or more inches from the chuck, a fixture shown in Fig. 14 was devised to overcome this obstacle. It consists of a special tool holder clamped to the turret, fitted with a bushing which can both turn and slide horizontally in the holder and in which the square end of the bar is clamped by four screws. Two of the screws are headless and are not to be moved after once set to a certain size. The two square head set screws are used to clamp the bar.

At the back of the holder is a clamp for supporting a stationary tool indicated in the sketch. After the bar is clamped in the sliding bushing the carriage is fed up until the cutting edge of the tool bears against the edge of the bar, the holder sliding over the bushing in which the bar is clamped. The bar and bushing, of course, rotate together. The corners of the bar can thus be turned off for a short distance, say, one-quarter inch, and to the desired diameter, making a seat for the turner brackets or the back rest supplied with the turners that are furnished in the outfit supplied with the flat turret

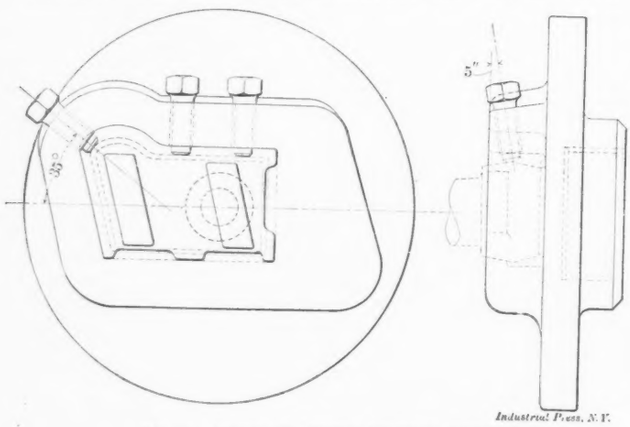

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Fig. 16. Chuck for Holding Irregular Work.

lathe. Having once started the cut in this way, the regular turners will finish the piece.

Fig. 15 needs very little explanation, as the cut explains itself. Long rolls or connecting rods from two to six feet in length, that are only required to be finished on each end, can be handled to good advantage with this fixture, it being only a simple bracket clamped to the end of the head with a sliding bushing holder adjusted to a perfect alignment with the axis of the spindle.

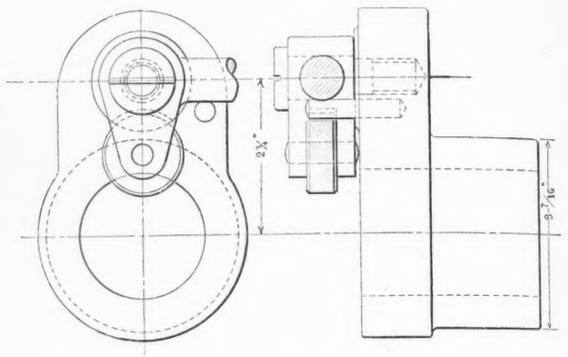

Fig. 17. Knurling Tool.

Fig. 16 represents a cast iron clamp chuck to hold an irregular forging with a shank to be turned and body faced. The dotted lines indicate the rough forging. This is finished in almost the time that an ordinary workman would take to center it for turning.

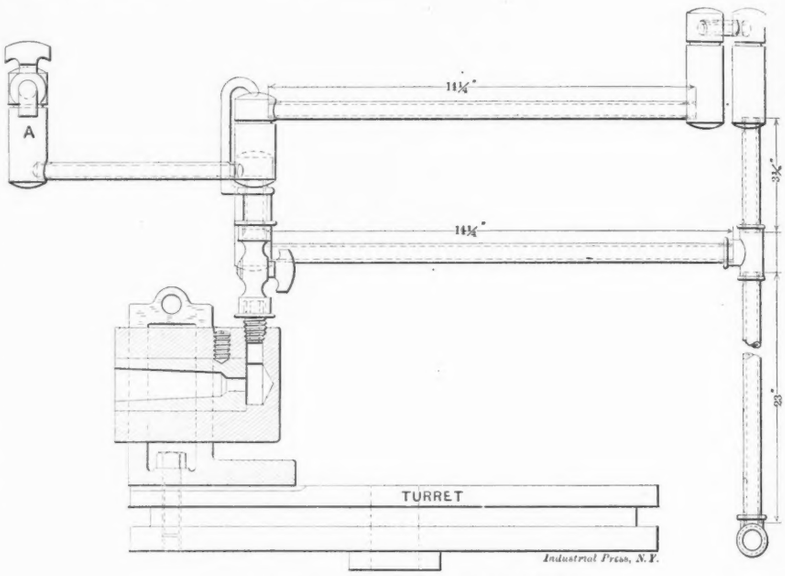

Fig. 18. Oiling Arrangement when Drilling.

Fig. 17 is a knurling tool, operated by a lever. This was not designed to be adjustable to different sizes, the object being, when a large quantity of pieces were to be made and knurled all exactly alike, that by bringing the lever down to the stop pin the knurling would be accomplished without any particular precaution being taken by the operator, thus facilitating rapid results.

Oiling Devices.

Fig. 18 represents a drill oiling device that is just a simple arrangement of piping with a special bushing held by the regular tool holders on the turret. It is intended, of course, to be used with oil tube drills and is shown for taper shank drills, but can be used for straight shank drills as well. The pipe connections are those usually supplied with the flat turret lathe, special joints being provided to allow for adjustment of the pipe. While the oil is supplied to the drill another branch of the pipe supplies oil to the external surface of the work through the thumb cock at *A*. This is essential, as it keeps down the temperature and therefore allows more rapid drilling. The device does not interfere with the revolution of the turret, or with other devices or tools that may be used on the turret in unoccupied places.

Fig. 19 shows the device as arranged when several drill holders are to be used on the turret. Only one holder is

shown in this view. It is connected to a central distributing joint at point *A*. Connection to another holder may be made at point *B*, and similarly there may be other connections at different openings, not shown. The upper part *C* of this joint is stationary and connects with the supply pipe *D*. The lower part of the joint revolves with the turret and leakage between the revolving and the stationary parts is prevented by the action of the spring *S*, which keeps the flanges of the two parts pressed tightly together. The interchangeable system

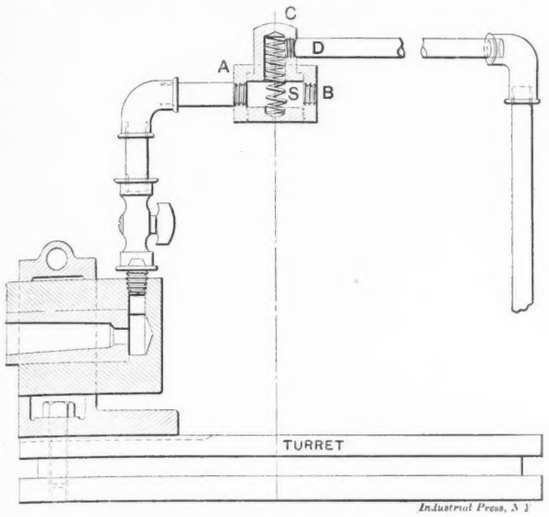

Fig. 19. Oiling Arrangement where there are Several Drills.

practiced in the manufacture of the flat turret lathe makes it possible to apply the device either to an old or new machine after being shipped from the factory. Fig. 20 is a device applied to the Hartness automatic opening die for cutting taper threads, when the taper is longer than the width of the chasers. The taper is limited to the amount of throw in the cam that opens the die. The operation is as follows: The die is closed and slid back on the former guides, in the position shown in the cut, the internal main spring holding

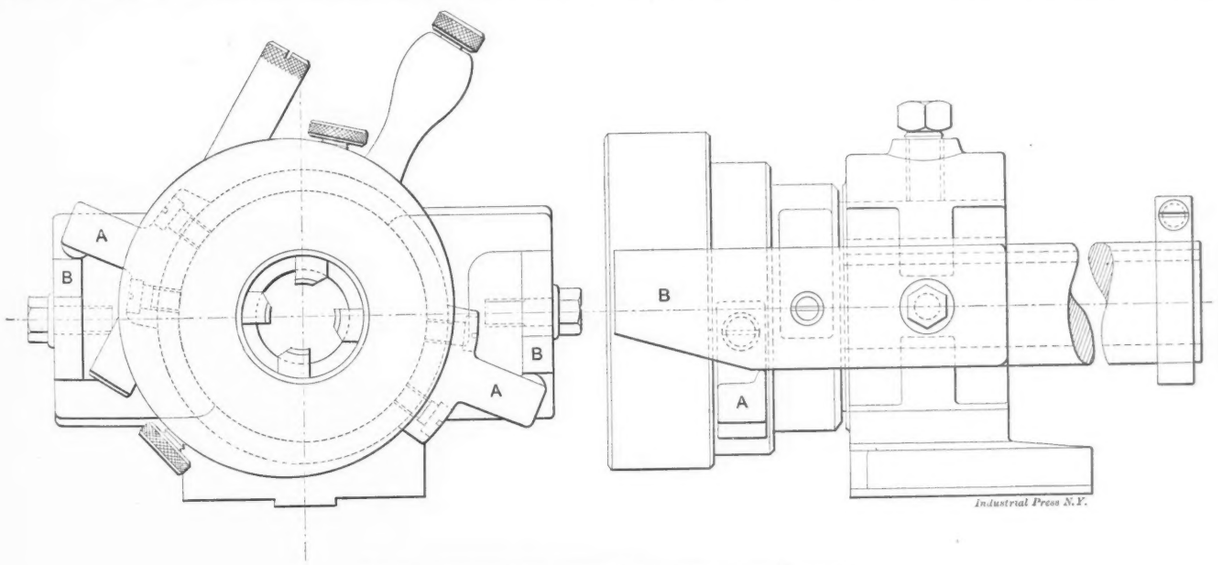

Fig. 20. Automatic Die Arranged for Cutting Taper Threads.

the lugs *A A*, which are fast to the spring sleeve, firmly against the guides *B B*. The piece to be threaded is first turned to the required taper, then the carriage is run up to a positive stop, allowing the chasers to get hold enough to draw the die along the guides until it has passed the ends, when it opens up ready to draw back. The taper on the guides must be of the length required for the screw.

* * *

An automobile road contest from New York city to Buffalo has been arranged for. The test will occupy six days and the start will be made from New York on September 9.

POWER TRANSMISSION BY BELTS.—2.

THE CONDITIONS WHEN BINDER PULLEYS ARE USED.

FORREST R. JONES.

The system of belt transmission in which idlers are introduced to secure a large angle of belt wrap will now be taken up and calculations made for the same three diameters of pulleys, viz., three, six, and nine feet, as have already been used. Fig. 8 shows one pulley and idler of this system. The idler is so placed as to secure 270 degrees, or three-quarters of a circumference, of the belt wrap. The pulley is three feet in diameter, as for the first of the preceding cases. The use of the diagram, Fig. 5, in making the calculations is exactly the same here as before; but, on account of having 270 degrees of contact instead of 180 degrees, the diagonal line marked 81 for the value of *fa* must be used. The velocity and centrifugal tension are the same as for Fig. 4. Other values are $p = 218$; $P = 438$; $T_1 = 603$; $T_2 = 165$; $A = 2.01$ square inches; and the effective tensions are 578 and 140 pounds.

The effective tension of 578 pounds acts horizontally on the 3-foot pulley, but the effective tension of 140 pounds on the slack side of the belt acts vertically on the same pulley. The resultant of these two forces, acting at right angles to each other, is obtained graphically in Fig. 9, and has a value of 595 pounds. The idler pulley has a tension of 140 pounds in each stretch of belt running from it, which acts to force it against its bearings. The resultant of these two forces is, according to Fig. 10, 198 pounds.

A 6-foot pulley with a belt contact of three-quarters of the circumference is shown in Fig. 11, on the following page. The velocity and centrifugal tension are the same as for Fig. 6. Other values are: $p = 188$; $P = 219$; $T_1 = 350$; $T_2 = 131$; $A = 1.17$ square inches; the effective tensions are 289 and 70 pounds. The forces tending to cause pressure at the bearing are 297 pounds for the 6 foot pulley, and 99 pounds for the idler, as obtained in Figs. 12 and 13.

Fig. 14 shows the 9-foot pulley with a three-quarter circumference belt contact. The velocity and centrifugal tension are the same as for Fig. 7; $p = 139$; $P = 146$; $T_1 = 315$; $T_2 = 176$; $A = 1.05$ square inches; effective tensions equal 193 and 47 pounds; the resultants of the belt tensions which cause pressure at the bearings are 198 pounds for the 9-foot pulley, and 66 pounds for the idler, as shown in Figs. 15 and 16.

By comparing the three drives having 180 degrees arc of belt contact on 3-, 6-, and 9-foot pulleys, as shown in Figs. 4, 6, and 7, with each other, it can be seen that the bearing pressures, neglecting weights of parts, are inversely as the diameters of the pulleys; the pressure in the 6-foot pulley is one-half, and in the 9-foot pulley one-third of that in the 3-foot pulley. The greater weights of the larger pulleys will, of course, have a greater effect in increasing the pressures upon

their bearings than in the case of the small one. It is hardly expedient to attempt a comparison of the weights of the pulley and shafting on account of the different designs which may be used for the pulleys.

The amount of belting which may be required for each of the three drives having a 180-degree arc of belt contact may be determined and compared with the others in order to see which will require the most belting. The method of doing this is to assume a distance between pulley centers and then compare the number of square feet of surface on the part of the belt coming in contact with the main pulleys. It will be assumed that belting 5-16 of an inch thick is used; also that the distance between pulley centers is 30 feet. The length of the belt for the 3-foot pulleys will therefore be $(2 \times 30) + 3\pi = 69.4$ feet. Its width equals $2.5 \div 5\text{-}16 = 8$ inches, and the superficial area equals $8\text{-}12 \times 69.4 = 46.3$ square feet. For the 6-foot pulley the length is $(2 \times 30) + 6\pi = 78.8$ feet; width is $1.44 \div 5\text{-}16 = 4.6$ inches; and the area equals $4.6/12 \times 78.8 = 30.2$ square feet. For the 9-foot pulley the length is $(2 \times 30) + 9\pi = 88.3$; the width equals $1.3 \div 5\text{-}16 = 4.16$; area equals $4.16/12 \times 88.3$ feet $= 30.6$ square feet. These results show that the two larger pulleys take practically the same amount of belting, although it is narrower on the 9-foot pulley than on the 6-foot. The 3-foot pulley takes about 50 per cent more belting than either of the other two. The very considerable centrifugal action for the largest pulley has much to do toward requiring as much belting for it as for the 6-foot pulley.

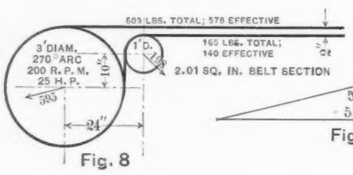

Fig. 8

Fig. 9

Fig. 10

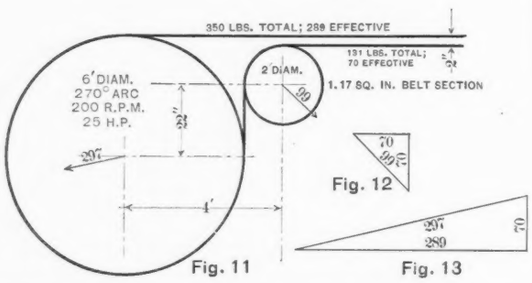

Fig. 11

Fig. 12

Fig. 13

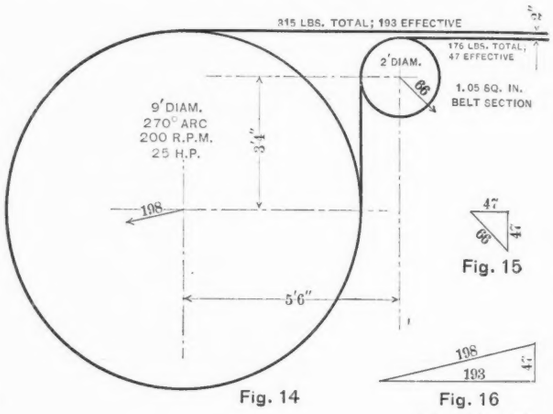

Fig. 14

Fig. 15

Fig. 16

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A comparison of the three drives, each having the 270 degrees arc of contact, with each other, shows that, as in the other drives, the bearing pressures are inversely as the diameters of the main pulleys, neglecting as before the weights of the parts. The length and superficial areas of belts 5-16 of an inch thick for the three drives are as follows: For the 3-foot pulleys, Fig. 8, length 73.4 feet; width 6.43 inches; superficial area 39.3 square feet. For the 6-foot pulleys, Fig. 11, width 3.74 inches; length 87 feet; superficial area 27.1 square feet. And for the 9-foot pulleys, width 3.37 inches; length 101.2 feet; superficial area 28.3 square feet. It will be seen that for these, as for the 180 degree arc of contact, the 6-foot and 9-foot pulleys require nearly the same amount of belting, which amount bears practically the same ratio to that for the 3-foot pulley, as in the case for the 180-degree arc of contact.

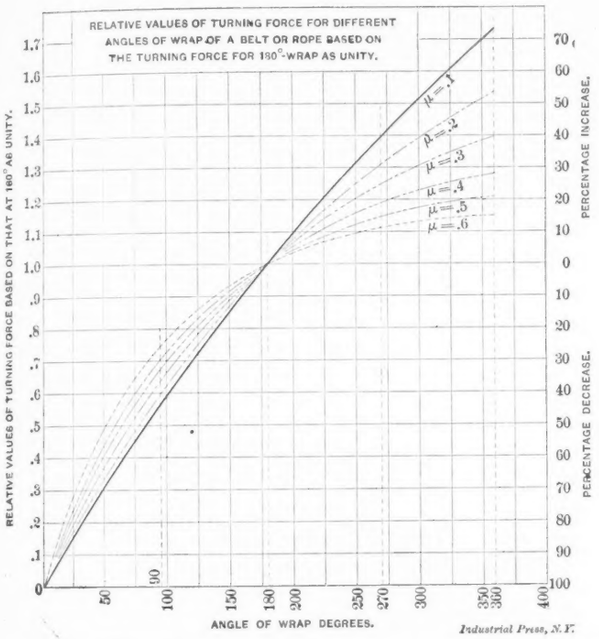
Now, comparing the two systems with each other, it will be seen that, for pulleys of the same diameters in the two systems, the pressure on the main shaft bearings for 180-degree arcs of contact is about 25 per cent greater than the sum of the pressures on the main shaft and idler bearings of the 270-degree arcs. The reduction of bearing pressure is not great as measured in pounds. There would not be as much power loss per pound of pressure upon the idler bearings, ordinarily, as per pound of pressure on the main bearings, since the idler shaft would usually be found considerably smaller in diameter than the main shaft; and, on account of its smaller journals would absorb less power on account of the smaller extent of the rubbing between the bearing surfaces. No great saving in the amount of belt required is obtained by the introduction of the increased angle of wrap, and there are additional pulleys and their necessary supports. So far, therefore, as economy of installation goes, the straight stretches of belt with 180-degree arcs of contact have the advantage. But the system with large arcs of contact and idler pulleys, in addition to being more economical for transmitting power, on account of the reduced bearing pressures, has, owing to the use of one of the idlers to adjust the tension in the belt, one very great advantage over the other system, inasmuch as the belt can be made endless (with cemented joints) and need not have any portion cut out for a very long period of time under ordinary service, if the material is good. Such a belt may run for six or eight years, or even longer, without re splicing. The belt without idlers, when the distance between pulley centers is fixed—as is usually the case—is almost invariably made much tighter when first spliced than is necessary to transmit the power in order to allow for stretching which goes on constantly. On account of this excessive tightness the belt wears out rapidly, and the bearing pressure is made correspondingly high, thus becoming much greater than indicated by the calculations. The high bearing pressures cause more rapid wear and greater power loss at the bearings than should occur. The introduction of idler pulleys naturally brings the two main stretches of belt near together. On account of this, the belt can be run from floor to floor of a factory without occupying near so much floor space as would be taken up by the 180-degree system. It may also be run near the ceiling, between pulleys on the same level, thus leaving more head room. The narrowness of the belt makes it much easier to adapt it to connecting shafts at angles with each other, than those requiring quarter turns of belt.

There are unquestionably many places where the system with large angles of belt wrap can be used with great advantage on parallel shafts, as well as on those at an angle and either on the same level or at different heights. It is especially adapted to connecting shafts that are near together and run at greatly different speeds. The writer has seen this system in use in numerous places. Some of the drives have been running eight years or more. Most of the belting used on them is of the best quality, which partly accounts for the fact that few of the belts have ever been shortened except by adjusting the tightener pulley. This means a complete absence of both the delay and cost of re-splicing, such as frequently occurs when there is no other means of adjusting the tension. Properly installed, it is smooth-running and quiet. The belt speed is generally high. Leather-faced or wood-rim pulleys are generally used.

Regarding proper installation, the length of the short vertical stretch of ten inches in Fig. 8 is less than should be used for high speeds. This distance should be a foot and a half or more. If less, there is apt to be noise caused by the stiff parts of the belt at the cemented joints striking a blow against the pulley where the short stretch runs on the rim. A notable instance of longevity of a belt on one of these drives now

running, and used for transmitting about 10 H. P. between a pair of horizontal shafts at a right angle on the same level, came under the observance of the writer. The entire belt is directly over and about six feet above a vat containing a dyeing solution kept at about the boiling temperature of water. The entire belt is continually enveloped in a cloud of vapor from the vat. But notwithstanding these exceedingly trying conditions, the belt has given constant service for more than five years without having once been repaired or re spliced. The slight amount of stretch has been taken up by an adjustable guide pulley.

Changing the extent of the angle of wrap has a decidedly greater effect upon the driving power of the belt when the coefficient of belt friction f is small than when it is large. This is shown clearly in the diagram, Fig. 17. In this diagram the turning force of the belt having 180 degrees arc of contact, or a wrap half-way around the pulley, is taken as a basis with which the turning force for both greater and smaller angles of wrap is compared. This diagram shows that, by increasing the angle of wrap from 180 degrees to 270 degrees when the coefficient of friction $f = .3$, there is a gain in the turning force of the belt of 24 per cent; for the coefficient of friction of .1, the gain is nearly 40 per cent; while, for $f = .6$ the gain is only a little more than 10 per cent. This means that the driving power of a given belt, always running at the same speed and working at the same total tension on the tight side, will have the same percentage gains in the amount of power it will transmit. In the same way, by decreasing the angle of wrap from 180 degrees to 90 degrees the loss is 36 per cent for $f = .3$; 44 per cent for $f = .1$; and 26 per cent for $f = .6$. This points out clearly that more is gained by increasing the angle of wrap for belts which run in damp places and that have consequently a low coefficient of friction, or in which the coefficient of friction is low from any other cause.



[In this diagram and the one published in the last number the coefficient of friction is represented by the Greek letter "mu." In the text the coefficient is represented by the letter "f."]

* * *

It is important that workmen having to do with erection or use of apparatus like elevators in which wire rope is employed should know how to properly secure the ends in the hooks or loops provided for attachment to the car or other parts. As is generally known, the hole in such parts is made funnel-shaped, with the smallest part of the hole just large enough to admit the rope before being untwisted. The end of the rope should be drawn through the hole, untwisted for a short distance and the ends bent inwardly (not outwardly) and back on themselves. The enlarged end is then drawn into the socket and melted babbitt metal poured around and into it, forming a secure fastening which will be as strong or stronger than the remainder of the rope. Quite often the mistake is made of turning the feazed ends outwardly and back on themselves and then pouring the metal around them. This form of fastening is unreliable and is prohibited by elevator inspection and insurance companies, as some of the most serious elevator accidents have been due to its giving way.

* * *

The uses to which platinum is put are very multifarious. It is employed to-day in the electric incandescent lamp as a fine wire for conveying the electric current through the glass walls of the bulb to the light-giving carbon filament within; in telegraph, telephone, and other electric apparatus for non-corroding contact points; in pyrometers, for the measurement of the temperature of blast furnaces and for determining the fusing point of other metals; in photography, in the production of platinotypes; and in chemistry for small crucibles used in fusing small quantities of chemicals. These are but a few of the many applications of this metal and its salts, but enough are enumerated to illustrate its wide and varied applications. The world depends for about 95 per cent of its annual supply upon Russia alone. Russia's output has increased steadily, and has just about kept pace with the enhanced demand. For last year the total was 13,242 pounds, a growth of more than 100 per cent since 1890, when the figure was 6,363 pounds. What is more, there is no reason to suppose that the deposits are becoming exhausted. On the contrary, new mines are being opened in the Ural Mountains. Outside of Russia the most promising sources of platinum production are New South Wales and the United States, although a little comes from the republic of Colombia and the metal is known to exist in Mexico.

* * *

DRIVING CHAIN SPROCKET CUT TO COMPENSATE FOR WEAR.

We have had our attention called by Mr. C. R. Garrard, of the Garrard Mfg. Company, Birmingham, England, to the manner in which they cut driving chain sprockets for bicycles, etc. Instead of cutting the sprockets to the same pitch as the chain when new, they follow the practice of cutting the sprockets of greater pitch than the chain, to allow for the inevitable wear and consequent elongation of the latter. The sprockets for a roller chain are cut so as to give a clearance of .09375 inch with a .318-inch diameter roller. The pitch of the sprockets being greater than the chain when new, the relative position of the sprocket teeth and the rollers of the chain is shown in Fig. 1. It will be observed that, with the

Fig. 1

Fig. 2

Fig. 3

sprocket teeth (which for convenience are shown in a straight line) moving in the direction of the arrow, rollers 1, 2, 3, 4 and 5 will be in engagement with the sprocket teeth. When the chain is approximately half worn out, the engagement of the rollers will be practically perfect with all the sprocket teeth as shown in Fig. 2. Then, as wear proceeds and the pitch of the chain increases, the engagement of the sprocket teeth will be reversed from that shown in Fig. 1, or as shown in Fig. 3, where rollers 12, 13, 14 and 15 are in engagement to drive in the direction to the left. In this way a wear equal to the length of about one link in fifty can be compensated for and the chain still run smoothly. It seems to us that this is better practice than cutting exactly to pitch when new, as the effect of the inevitable wear is better equalized.

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AUGUST, 1901.

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1900.		1900.		1901.		1901.	
Sept.....	21,750	Dec.....	27,500	March...	30,000	June....	28,000
Oct.....	24,000	Jan.,1901	27,500	April....	26,000	July.....	28,964
Nov.....	25,000	Feb.....	26,500	May.....	26,500	Aug.....	29,492

COMPRESSED AIR VS. ELECTRICITY.

It has been generally believed and conceded that compressed air and electricity each have a field for the operation of tools and appliances in which the other cannot successfully compete on account of natural limitations. Thus, for the operation of traveling cranes, electricity is peculiarly suited on account of the flexibility and smallness of the necessary connections making it much more convenient than compressed air with the accompanying awkward and expensive hose and apparatus, to keep it wound up out of the way. On the other hand, compressed air is believed to be peculiarly adapted to the operation of reciprocating tools, such as hammers, riveters, beaders, rock drills, etc. The design of these tools demands the use of a fluid under pressure for their operation and because of freedom from condensation and freezing, compressed air easily is the most practical medium to employ. Another advantage of compressed air in the operation of rock drills in mines is the escape of pure cold air from the cylinders, which is not an insignificant item in the maintenance of fresh air for the workmen.

Notwithstanding the limitations of electricity, it is now being most successfully used for the operation of reciprocating rock drills, and its use in this direction promises to largely supersede the compressed air type on account of the simplicity of the apparatus and the flexibility of the necessary connections, together with the ease of erecting main feed wires as opposed to the laying of air pipes. The latter are expensive in first cost and laying and sometimes troublesome on account of leaks. A leaky air pipe is harder to make tight than a steam pipe.

The reciprocating rock drill referred to uses a three-phase alternating current. It has two coils of wires forming solenoid magnets through which a solid steel plunger reciprocates. The plunger carries the drill. The remainder of the apparatus is similar to the ordinary rock drill in the matter of turning the bit and feeding it to the work. For the operation of the drill a three-phase generator is necessary, which is run at comparatively slow speed. Each drill on the circuit strikes a blow for each rotation of the armature and all strike at the same time. The whole apparatus is absurdly simple and it unquestionably raises a doubt in the minds of engineers as to the further supremacy of compressed air in its hitherto conceded field. The essential features of the drill referred to are not new, but it is only recently that it has been perfected and steps taken to put it in active competition with the other types, thus calling attention to possibilities not before generally known as to the practicability of employing electricity for the operation of reciprocating tools. It apparently behooves the wide-awake machinist to become thoroughly familiar with the principles of electricity and the features of electrical apparatus, as it will more and more be necessary for him to have such knowledge as time passes by.

* * *

HEAT DEVELOPED BY FRICTION.

In the catalogue of the makers of the Morse bicycle chain we notice an interesting statement regarding the heat generated by the joint friction of an ordinary bicycle chain when run under heavy stress and at comparatively high speed. It is to the effect that a standard bicycle chain mounted on two sprockets so as to be driven by power and driven at the rate of about 400 feet per minute under a stress of 600 pounds will in a very short time develop a temperature sufficient to boil water, or 212 degrees F.

It is obvious that a chain drive working under such circumstances would be a failure, as it would be impossible to keep it lubricated so that there would be rapid destructive wear in the joints. To those familiar with the ordinary conditions under which a bicycle chain is operated, the above statement may be surprising, especially if they have ever contemplated its use for driving high speed machinery. But under the circumstances mentioned, the power transmitted is probably ten or twelve times as much as would be developed by the most ardent racing bicyclist, so it is not so surprising that the heat from friction is developed more rapidly than it can be carried off by the surrounding atmosphere. The same phenomenon is often encountered in machinery. A machine has been successfully operated at a certain speed with no trouble from hot bearings, etc. To increase the production this machine may be speeded up or another machine designed and built to run at a considerably greater speed. The result under both conditions often has been that trouble, if not failure, resulted simply because the critical point had been passed at which more heat was generated by friction than could be carried away by the ordinary circulation of the surrounding air. In any ordinary bearing friction causes heat. If operated at low speed, the heat is carried off without perceptibly increasing the temperature of the bearing, but as the speed increases, the mean temperature of the bearing will increase until a temperature is reached at which ordinary oils fail to properly lubricate, so that any increase of speed or pressure beyond this critical point becomes rapidly destructive. Another point to remember is that an insulated bearing, that is, one so supported that heat cannot be readily transmitted from it by metal conduction, will heat more readily than one which forms a portion of a frame or a metal body considerably larger than itself.

* * *

NOTES AND COMMENT.

We have received a letter from a subscriber at Ogden, Utah, relative to the record of John K. Cannan, of that place, who has recently retired from the machinists' trade. He started to serve his time when a boy of fourteen years at Manchester, England, and came to this country at the age of twenty-one years, going to work at Buffalo, N. Y. Later he was employed at Fort Wayne, Ind., and finally moved to North Platte, Neb., to work for the Union Pacific Railroad Company, from which place he retired last fall to live in Ogden, Utah. He worked at the machinists' trade continuously for fifty-eight years. This is one of the longest records that we have heard of, and we are sure that it must be a source of pride to Mr. Cannan. He has always been a reader of technical papers and has been an occasional contributor himself.

An electric car brake has been brought out by the Westinghouse Electric Company which has a number of features

of an interesting character. The braking force is supplied by the attraction of a double track-shoe which is powerfully magnetized when stopping the car. The attraction of this track-shoe to the rails materially adds to the effective braking weight of the car. As the magnetized shoes come in contact with the tracks, the friction of contact tends to leave them behind and as a result the brake shoes on the wheels are forced against the wheels, suitable means being provided to transmit the thrust to both wheels of each truck. The brake automatically adapts itself to the conditions of the rail and also gives greater braking force on the forward wheels. This is as it should be, since the stopping of a car naturally throws greater weight on the front wheels than on the hind ones.

The term Miner's Inch has been more or less indefinite until recently, when the legislature of California passed an act defining it as equivalent to one and one-half cubic feet of water per minute, measured through any aperture or orifice. The most common method of measuring the flow of water by this standard is to use a 1¼-inch plank in which a slot is cut two inches wide and of the length required. When the plank is so placed that the slot is horizontal, its bottom edge two inches above the reservoir from which the water flows and the top edge five inches from the surface of the water, it is in the correct position. This will give a six-inch head above the center of the stream flowing through the aperture. Each square inch of the opening will represent a miner's inch, and approximately one and one-half cubic feet of water will flow through each square inch per minute.

In American railway practice it is customary when tubes have been removed from locomotives to weld on short sections of new tubes to compensate for the portions necessarily spoiled in removing them. It appears to be the practice on some foreign railways to stretch the tubes the amount necessary to make up for that spoiled instead of welding on new sections. We are not informed how the process is economically performed or how many times a tube may be safely stretched before being condemned. The welding on of short tube lengths is a troublesome and expensive job and one which always results in some defective work. On the other hand, it would appear to be a difficult matter to stretch them evenly so that all sections would be of the same thickness. The tendency would be for the stretching process to take place in one portion of the tube while the greater part would remain unaffected.

At the works of the Stow Manufacturing Co., Binghamton, N. Y., a small cold saw is used for cutting off rods, pipe, etc. It is arranged so that the saw runs in a pan filled with oil for the purpose of lubrication, about one-third of the saw diameter being immersed in the oil. Much trouble was found with the oil being carried onto the work and running from thence to the floor, causing considerable waste and a filthy condition of things generally in the immediate vicinity. One of the workmen experimented a little to stop the trouble and finally hit on the scheme of partially filling the pan with water and pouring the oil on top. After doing this the oil no longer flooded the work, although enough was carried to it by the teeth of the saw to keep them lubricated sufficiently to work properly. If this is an old idea it was independently discovered there and will undoubtedly be new and a welcome one to others placed in a similar vexing position.

RAPID TRANSIT FACILITIES.

It is evident that within a few years the sections adjacent to New York city will become so closely related through the development of rapid transit facilities as to justify the political change which brought them under the single government of Greater New York. The second bridge connecting New York with Brooklyn is gradually approaching completion, and within a few weeks the Rapid Transit Commission has taken the final steps to insure the construction of the tunnel from the downtown business district of New York city proper—the borough of Manhattan—to the terminus of the Long Island Railroad, in the center of Brooklyn. Recently, also, it was announced that the latter road would construct still another tunnel from the center of the uptown business district of Manhattan to the terminus at Long Island City, near Brooklyn. That these two undertakings will be carried out is all the more probable because of the rapid progress that is being made upon the tunnels connecting the northern and southern sections of Manhattan Island. These various enterprises will afford relief for the congested sections of New York city, surrounded as it is by water, and where the only chances for growth have been either northward, or upward by the erection of tall buildings. They will also make New York city the center of a number of the most gigantic engineering enterprises that have ever been attempted.

CANADIAN NIAGARA POWER DEVELOPMENT.

The task of developing the power of Niagara Falls on the Canadian side has been commenced by the Canadian Niagara Power Company. The initial installation will consist of an inlet canal, a wheelpit and a tailrace tunnel, the arrangement being very similar to that of the extensive development on the American side at Niagara, with the necessary electrical and hydraulic equipment for a capacity of 25,000 horse power, and provision in the wheelpit for extension to 50,000 horse power and in the tailrace to 100,000 horse power. The first section of the wheelpit, which is now being excavated, will be about 250 feet long and 200 feet deep. The tailrace will be built in the form of a horseshoe, as on the American side, but will need to be only 2,200 feet long as compared with the American tunnel of 7,000 feet in length.

The opposition to this power development, which has previously been urged by the Canadian Government, seems to have been removed, although the Canadian Niagara Power Company are under an agreement to expend the sum of $1,500,000 within two years, or sooner if possible, upon the work.

It is probable that within two years the power house will be in operation and furnishing power. As all the power developed on the Canadian side must be used outside of Queen Victoria Park, which is the national park bordering upon the Niagara River, it is probable that considerable quantities of power will be transmitted to Hamilton, Toronto, and other places, and also that an extensive industrial development will take place on the vacant tracts of land in the vicinity of the Park.

STUDENTS FROM ABROAD.

It is pleasing to note that the Massachusetts Institute of Technology, Boston, is to hold entrance examinations this year in London for the benefit of students in England or on the continent who desire to secure a training in industrial science at an American school. The motto of the Boston Institute is "Mens et Manus" (Mind and Hand), and the spirit of this motto was carried out by the early establishment of laboratories and shops and the introduction of field and drawing-room work to teach the practical application of the theories and principles learned in the class and lecture room.

This idea has also been carried out in nearly all of the technical colleges and schools of America, and in this important respect there is no doubt that American schools are far in advance of similar institutions abroad. The fact that there have been enough applicants for admission to the Massachusetts Institute of Technology from England to make it expedient to hold special examinations in London, is significant. It indicates in a small way, at least, that American educational methods are appreciated there as well as in this country. It probably indicates, also, that the successes of American engineering and manufacturing firms in securing contracts in foreign markets have led to a desire on the part of foreign students to secure their practical training under American auspices. It is natural that the large number of young men who come to this country every year to engage in technical work should prefer to secure their education where they can become familiar with American practice and thought, rather than to have to become accustomed to our ways and methods after entering into commercial work.

CHAINS AND CHAIN GEARING.

ABSTRACT OF A PAPER READ BY CHARLES PIETZ BEFORE THE ENGINEERS' CLUB OF PHILADELPHIA.

Chains have so well established a place in the mechanical world as a means for transmitting power that it is necessary to say but a few words concerning their scope. They are applicable wherever a positive speed ratio is to be secured, wherever heavy strains at low speeds are to be transmitted, wherever a damp or hot atmosphere would prove destructive to belts or ropes, and wherever power is to be transmitted without sacrificing the flexibility of the shaft supports, as in the case of agricultural machinery.

Just as gears may be roughly classed as cut and cast, so chains can be grouped as machine-made and cast. The former have been almost solely applied to bicycles and motor cars, while the latter are applied to elevating, conveying, and the transmission of power in the mechanical arts. The limitation to the use of machine-made chain is almost wholly a matter of price and is due very largely to the fact that its manufacture has never been so systematically organized as to produce a well-made chain and sprocket wheel at a reasonable price. Machine-made chains, when properly designed and well made, are stronger, more durable, and less noisy than cast chains of equivalent bearing surface and section. But owing to their lower first cost, the latter have been much more extensively used.

I described machine-made and cast chains as resembling cut and cast gears in their classification; I might carry the simile further by stating that there is as much difference in cast chains as there is between well-made machine-molded gears and gears cast from carelessly made patterns. That chains shall run properly with their wheels it is essential that the links shall be accurate as to pitch, that the pintels shall bear uniformly in their seats, that the wheels shall be of the proper pitch diameter, the teeth of proper pitch and shape, and that the bearing and sprocket surface shall be proportionate to the strains to be transmitted. The last requirement is one that can be overcome by proper design, but those who are familiar with the "vagaries" of castings can imagine how difficult is the realization of the other four requirements. The high-class Ewart malleable chains are subjected to seventeen distinct operations after removal from the annealing pots, and while primarily cast chains, they are by selection, by treatment, and by testing, brought to an accuracy and uniformity which leaves but little to be desired.

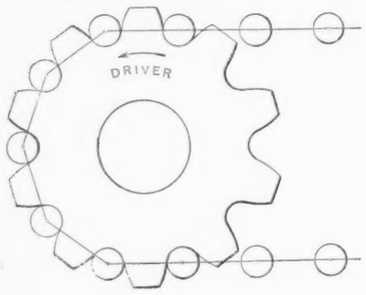


Fig. 1.

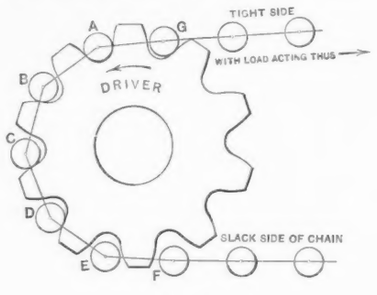


Fig. 2.

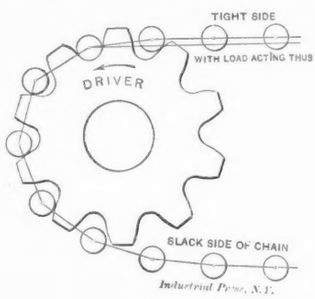


Fig. 3

Faulty Construction of a Driver when used with a New Chain, a Chain slightly Worn and a Worn Chain.

Wear of Chains Lubrication.

The wear on chains is twofold, internal and external. The internal wear is due to the articulation of the links, and takes place between the pintel, or what in Ewart chains is termed the end-bar, and its bearing. The external wear is that which is caused by the engagement of the link with the sprocket.

Lubrication of both the chain bearings and the teeth of the wheels would largely reduce both kinds of wear, and in the larger chains used for dredges, special provision for properly lubricating the chain bearings is made. But these provisions are applicable only to very large chains, and even were they not so limited, the cost of such devices when applied to the smaller chains would stand in the way of their general adoption. Every chain, no matter what its duty or what the atmosphere it runs in, should be lubricated at frequent intervals, tests having demonstrated that a chain lasts longer when a mixture of graphite and oil is applied to the chain than when the graphite alone is applied. The joints should be wiped free from dust and sticky oil, and an effort should be made to get the lubricant into the bearing. Besides this, the teeth of the wheels should be cleaned and a heavy grease applied to them. In a large percentage of cases, when a chain gives trouble, such a treatment will give relief.

Anti-friction and Hardened Chain Joints.

Two general methods have been employed to achieve this result. The first method consists in the use of a rocking joint, which is an application of the knife-edge principle to the chain bearing. This application was the subject of a generic patent granted Mr. James M. Dodge, on July 13, 1880. Only a fractional part of a complete revolution is possible with this form of joint; but by limiting the number of teeth of the smallest wheel to be used, the arc of articulation can be brought within the practicable limits of the rocking joint. This joint is practically free from friction, even without a lubricant; and when the force to be transmitted lies well within the safe limits of the strength of the bearing edge, it gives excellent results in practice. The Morse * bicycle chain and the malleable iron rocker-joint chains are examples.

The second method to obtain a durable joint consists in hardening the surfaces in contact. In cast or malleable iron chains this is accomplished by using case-hardened steel pins bearing against bushes of hard metal. In the chain invented

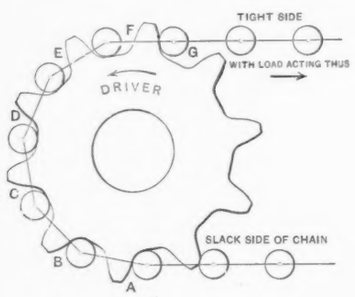


Fig. 4.

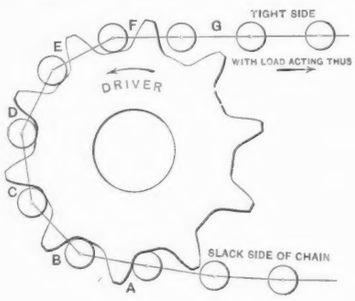


Fig. 5.

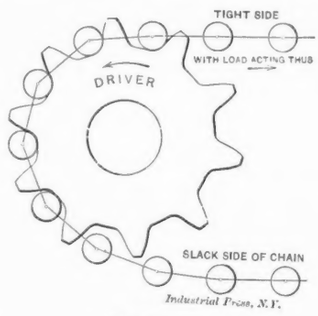


Fig. 6.

Correct Construction of a Driver when used with a New Chain, a Chain slightly Worn and a Worn Chain.

[* The Morse chain has a rocker joint bearing similar to that of a roller instead of a knife-edge bearing, as is quite generally supposed and as was intimated in the June issue.—EDITOR.]

by Mr. Francis Ley, of Derby, England, this principle is carried one step further. The cast frame is cut away so that the outer surface of the case-hardened bush bears against the wheel. Both the external and internal wear in this chain are therefore concentrated on case-hardened parts, and these parts are made so that they can be renewed when worn. As the external wear is wholly due to the action of the wheel on the chain, it will be necessary to give a brief description of the action of the chain on the wheel and the rules which should govern a proper wheel design.

Chain Action.

The popular notion is that when a chain gears into a toothed wheel, all the teeth entering the chain are simultaneously in action. This is not true, for no matter how accurately a chain and wheel may fit when new, the moment a strain is brought to bear on the chain, and the wheel begins to turn, the pins begin to bed themselves into their bearings, producing at once a lengthening of the pitch. The amount of this bedding or seating may be infinitesimal in each joint, but it is sufficient to destroy the simultaneous bearing on all teeth. The action between chain and wheel tends to wear the chain long and the wheel small, and results in one tooth doing all of the work at any one time. The following cuts will illustrate the principle of chain gearing with the ordinary types of chain:

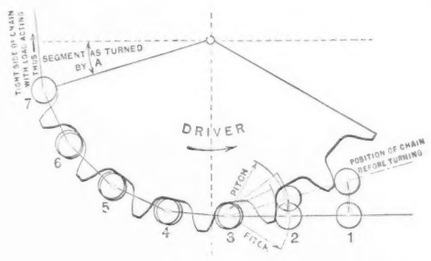


Fig. 7. First Stage of the Outgoing Chain.

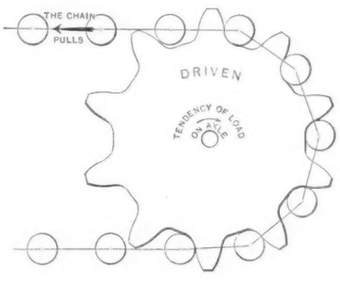


Fig. 8.

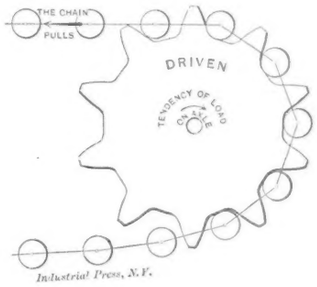


Fig. 9.

Correct Construction of a Driven Wheel when Gearing with a New Chain and with a Worn Chain.

Fig. 1 shows a wheel with a chain fitting every tooth. This is an ideal condition that may exist before the gearing has been put into operation and when the chain and wheels have been made with extreme accuracy. But this condition ceases as soon as the chain runs long enough to bring the joints to a bearing. Then the chain approximates the position on the wheel shown in Fig. 2, which represents the wheel shown in Fig. 1, when gearing with a chain slightly worn.

The link *A* is now the only one which is in working contact with its tooth, the reason being that the chain has lengthened, whereas the wheel has remained the same. As the wheel turns beyond the position shown in the figure, link *G* wedges itself into position and crowds out link *A*, throwing the latter into about the position shown by link *B* in Fig. 2. The work is therefore done by one tooth, and that, too, during the period when the tooth is acting like a wedge to prevent the seating of the link. Only a portion of the power, therefore, is usefully employed. Fig. 3 represents the third stage of the same wheel, viz., when gearing with a worn chain. In this instance the defects of the last case have become aggravated and the working of the chain becomes irregular, the links frequently jumping the teeth. The construction shown in the foregoing results in a waste of power, a rapid wear of the chain, and an irregular and jerky motion.

In Fig. 4 is shown the correct construction of the driving wheel, and this figure shows it gearing with a new chain. As will be seen, the wheel pitch is longer than the chain pitch, and the tooth space is much wider than the accommodation of the chain joint would require. This construction brings the driving tooth at the outgoing end of the chain instead of the incoming end. Fig. 5 shows the same driver gearing with a slightly worn chain. The driving is still done by the tooth engaged with the outgoing link, but links *B*, *C*, *D*, *E*, and *F* have moved closer to their teeth without touching them. Fig. 6 shows the correctly constructed driver gearing with a much worn chain, and in this case the conditions, after a long and useful life, approximate those of the new chain when gearing with an incorrectly constructed driver, as shown in Fig. 1. To secure the proper operation of the chain, the driving face of the tooth should be so curved as to permit the outgoing link to readily free itself. The release must at the same time be gradual, so that the following link will slip back into engagement with the sprocket without jar. The proper design of the tooth face is shown in Fig. 7, which shows the first stage of the outgoing chain.

As the foregoing cuts have shown the advantage of making the driver wheel longer in pitch than the chain, so the two following cuts will point out the advantage of making the *driven* wheel slightly shorter in pitch than the chain. In practice, the chain and wheel pitch are made alike, because the lengthening of the chain as soon as it is set to work produces at once the desired effect.

Fig. 8 shows the correct driven-wheel gearing with a new chain, and Fig. 9 shows the same wheel gearing with a worn chain. It is apparent that in the driven wheel, as with the driver, the tooth against the outgoing link is the one in action.

Mr. W. D. Ewart, in his invention of the differential pitch sprocket wheel, has combined the principles that the driver-wheel pitch shall be large and the driven-wheel pitch small, in a single wheel.

A careful study of the action of a chain gearing with a wheel shows that unless the wheel face is kept well lubricated, which in practice is rarely the case, a more perfect action is secured by the type known as the roller chain than by the ordinary solid joint chains like the block chains or Ewart chains, because the release of the outgoing link and the slipping back of the remaining links is accomplished with less jar and with less wear on the external part of the chain joint by rolling than by sliding. The ratio of the roller to its pin should be as large as the strength of the chain will permit, but without encroaching too much upon the tooth space

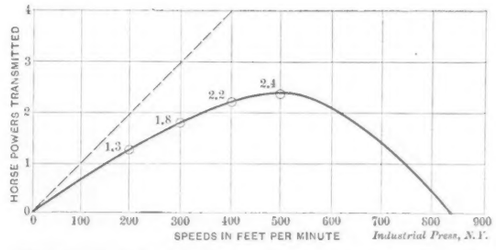


Fig. 10. Decrease of Horse-power with increase of Speed.

of the wheel; for the above analysis also points out the fact that the greater the number of teeth, the larger must be the space between them in order to take care of the elongation of the chain when worn. This means that the larger the number of teeth, the thinner the tooth. This is sound from a practical standpoint, because, chain speeds being the same, the greater the number of teeth, the less frequently does each tooth come into action. There is a limit to the number of teeth which a wheel should be given, and this limit—not the possible limit, but the practical limit—can be set down at 100 for cut wheels gearing with accurately pitched machine-made chains, and at less than half this number for cast wheels and cast chains.

It is evident from the foregoing cuts that in the operation of any of the ordinary chains, no matter how accurately

made, and no matter how correctly cut the wheel, the transfer of strain from one link to the following involves a blow which becomes more frequent, and therefore more severe as the speed increases. Take the case of a chain of 3-inch pitch traveling 900 feet per minute: Each foot of travel means the engagement of four links, and this speed, therefore, represents 3,600 blows to the chain per minute. The severity of the blows is still further increased by the fact that the chain at high speeds vibrates in both a vertical and a horizontal plane and strikes heavily against the face of the wheel in consequence. The heavier the chain, the greater the force of the blow and the quicker the destruction of the chain.

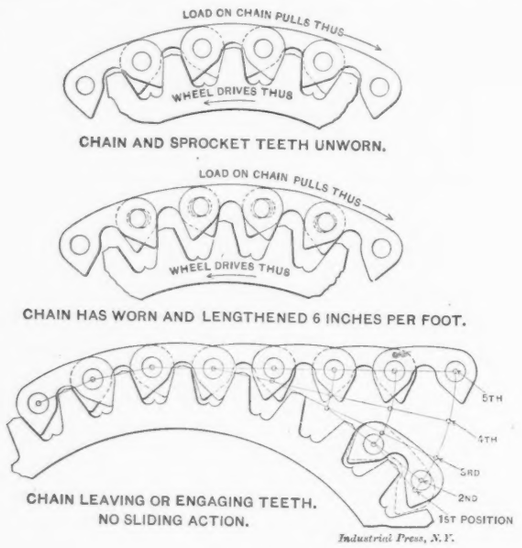


Fig. 11

In designing chains for high speeds, therefore, material of the very highest degree of strength and tenacity must be selected so as to keep down the weight. We have experimented for a long time on the determination of the proper strain which a chain can be called upon to transmit at various speeds, and while our experiments are not complete enough to tabulate, they show that, for malleable iron chains, for instance, the permissible strain must be quickly reduced as the speed is increased.

Power Transmission.

Suppose, for instance, that in the diagram, Fig. 10, page 389, the horizontal divisions represent speeds and the vertical divisions effective horse powers. Then, if we follow the generally accepted method of H. P. determination for chains, we will assume the permissible working strain to remain the same at all speeds and obtain the results shown by the straight dotted line. If, however, we take into account the rapidly increasing destructive effect of blows at high speeds, we will find that the effective power transmitted is represented by a line which assumes the shape of a curve, flattening as the speed increases and finally dropping back. The actual strain in chain, however, increases with the speed, and the chain can be run so fast that it will destroy itself without performing useful work. Our experiments fully bear out this theory, and indicate that a malleable chain at 200 feet can be safely run at twice the working strain of one at 50 feet, and that at 500 feet the chain will transmit its maximum power. These statements are all made, of course, on the assumption that the total strain existing in the chain—that is, the sum of the strain due to the driving force and that due to impact—shall be the same at all speeds.

Now, as stated above, the limitations to chain speeds are due, first, to the weight of chain; and, second, and more particularly, to the method of engagement.

High-speed chains must therefore be light; they must be accurately made as to pitch, and they must be made durable so they will retain their accurate pitch. The wheel must likewise be accurately cut and the teeth formed in such a way that the transfer of strain from one tooth to the following one is made with the least possible jar. But with all these requirements fulfilled, chain speeds of 1,000 feet per minute and upward are objectionable for most transmissions because of the noise. This noise is due wholly to the manner of engagement between the chain and chain wheels, and increases very rapidly as the chain stretches from wear.

Renold Silent Chain.

To Mr. Hans Renold, of Manchester, England, belongs the honor of having developed a driving chain which overcomes the defects inherent in the ordinary type of chains, and makes it possible to attain speeds of 1,200, and even 1,500, feet per minute, with as little noise as accompanies the action of a leather belt. This he accomplished by so designing the chain and wheel that the stretch is automatically taken up, or rather compensated, and the correct principle of chain gearing is preserved to the last. The compensation for stretch or wear is accomplished on the wheel by the chain assuming automatically a larger pitch diameter, this result being achieved by the peculiar form of link and tooth, as shown in Fig. 11. The incoming link seats itself firmly against the face of the tooth, and retains this position until its release at the other end of the driving arc. There is no transfer of load from tooth to tooth by slipping back, but the load is evenly distributed over all the teeth in gear, and the action is altogether silent and without the slightest trace of jar or jerk.

The "silent chain gear," as Mr. Renold has styled it, is very durable, and has lent itself to purposes where chains have heretofore been inadmissible. It seems strange to see a sprocket wheel on the shaft of a motor running 800 revolutions per minute, and to find a chain transmitting power from this motor to a countershaft with a speed reduction of five to one. And yet this chain does its work as noiselessly as a belt, and very much better than a cut gear and a rawhide pinion. The illustrations of this chain are so clear as to explain themselves, and demand no further description. As all the teeth in gear are simultaneously in action, and as this continues to be the case even when the chain becomes worn, it is evident that several chains can be run simultaneously on the same wheels, and that each will do its proper proportion of the work. This makes it possible to transmit large powers by using a number of chains side by side, and several very successful installations transmitting 150 horse power and over have been made by Mr. Renold in this way. Accurate workmanship in both chains and wheels is absolutely necessary, and machine-cut wheels must therefore be used.

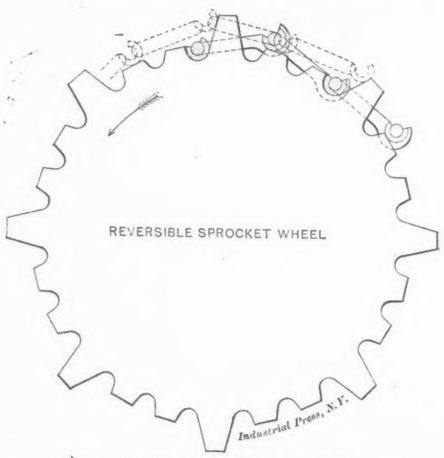


Fig. 12. The Dodge Sprocket Wheel.

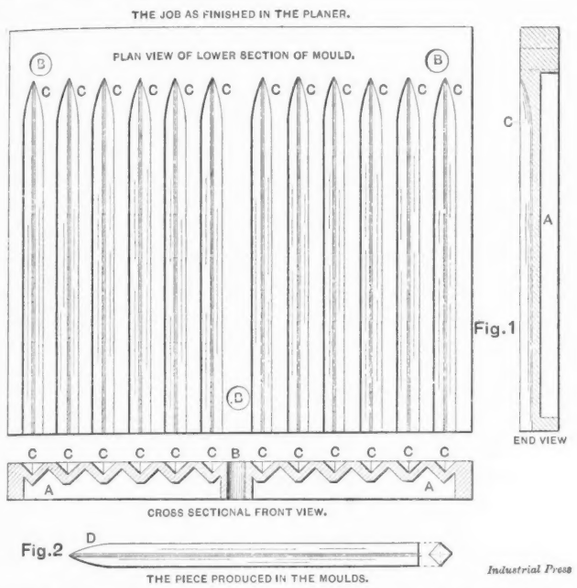
Several years ago Mr. James M. Dodge designed a sprocket wheel for use with the Ewart or other form of malleable iron chain, in which the wear of the chain is compensated for by its assuming a gradually increasing pitch diameter, as in the case of the Renold silent chain gear. The design, however, is quite different, as will be seen from the illustration, Fig. 12. In a long series of dynamometer tests, wheels of this design, made of chilled cast iron, have shown themselves indestructible when used as drivers, and have shown that by their use the life of the chain can be practically doubled.

LETTERS UPON PRACTICAL SUBJECTS.

HOW AN ACCURATE MILLING JOB WAS DONE ON THE PLANER.

Editor MACHINERY:

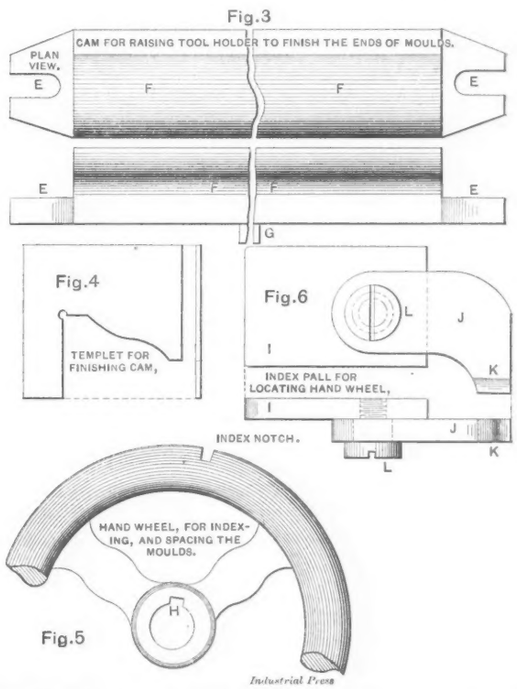
In Fig. 1 are three views of the finished lower section of a mold used for molding square sticks of crayons with one end curved and tapered, as shown in Fig. 2. There were ten sets of these molds to be made and as we were getting a good price for them, we were glad to get the job. Now, as will at once be seen, a job of this kind is what you would call an accurate milling job, and the universal milling machine is the one to use for it. As we had no milling machine, however (universal or otherwise), we had to look around for other means.



At last we decided that they could be finished throughout in the planer by the use of a few special tools and attachments. Fig. 1 shows how the sections of the molds are cored out at the back at *A A*, leaving a rim all round the outside. These sections, or plates, were of cast iron of very close grain. The twenty castings for the ten molds were first planed on the top and bottom, and the mold face of each scraped, so that the sections would surface at all points. The sections were then paired and the holes *B B B* drilled and reamed through them, in the position shown, for the three dowel pins, of Stubs steel. These pins were driven tightly into one section of each of the ten molds, and the holes in the other section reamed slightly larger to allow of the sections being easily separated. The two sections of each mold were then numbered and the molds, with the sections clamped together, were then strapped on the planer bed and their four sides planed square with each other and with the mold faces of the sections, care being taken to finish the lot of ten to the same width and length. We were now ready to finish the molds proper, and to do this the tools and fixtures shown in the accompanying illustrations were made.

As seen in Fig. 2, the crayons produced in the mold were required to be 5-16 inch square, with one end tapered and curved to a 1¼ inch radius. They were to be finished so that they would present a smooth surface on all sides, without fins and with the ends tapering symmetrically. To accomplish this result in the planer it was necessary to provide means for raising the forming tool (for finishing the molds) so as to produce the shape desired. The first thing made was the templet shown in Fig. 4. This templet, as will be seen, is worked out with one square side to work from, and then finished, as shown by the curved lines, to a 1¼ inch radius. It was used to finish the cam, shown in two views in Fig. 3, and on the planer bed in Fig. 9. This cam was of cast iron with ears at each end to admit fastening bolts, and with the cam face *F F* long enough to take in the entire length of the mold sections. It was first planed on the back and the tongue *G* fitted to the central slot in the planer bed. The cam face *F F* was then planed up and finished to the templet, Fig. 4, after making sure that it was at right angles with the sides of the tongue *G*. The front side of the casting was also squared so as to have a locating side for the mold sections to square against. Next came the tool holder, Fig. 8. This was made out of a bar of 1⅛ inch square mild steel, bent and drawn down one end to 1⅜ by ⅞, to the shape shown in the front and side views of Fig. 8. The end of the extension at *N N* was milled through with a ⅜-inch cutter to admit the roller *O* of machine steel, which was finished to fit the slot *N N* snugly, and to 1⅜ inches in diameter, and fastened by the 7-16 inch stud *P* to revolve freely within the holder. A ¾-inch square hole was worked through the holder to admit the forming tool, Fig. 7, care being taken to get it square with the sides of the roller *O*. Finally a hole was drilled and tapped to admit the set screw *Q* for holding the forming tool. This tool, Fig. 7, was of ¾-inch square tool steel, finished at *R* to a 5-16-inch right angle, terminating in a square surface on each side at *S*. The correct shape of the cutting portion was carried back to the full thickness of the tool, giving the cutting edge the amount of clearance shown. This completed the tools necessary to finish the molds in themselves.

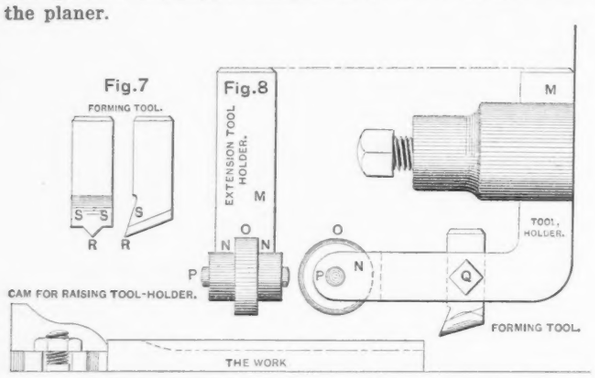
Now, as will be seen in Fig. 1, the molds are constructed to produce twelve crayons, and it is necessary to space the twelve molds *C* accurately, so that those in both sections will coincide with each other perfectly when the sections are fastened together. To do this some kind of an indexing device was necessary. The use of the notched handwheel, Fig. 5, and the "flopper" or index pall, Fig. 6, answered for this, and allowed of the spacing of the molds being accomplished with rapidity and very little trouble. This handwheel was



fitted to key onto the horizontal feed screw of the planer and has a notch cut into its rim in the position shown. The "flopper" or index pall consists of three parts: the back plate *I*, the flopper or pall *J*, finished at *K* to fit the notch in the handwheel, and the shoulder screw *L*, for fastening the parts together. This completed all fixtures necessary to the finishing of the molds.

The manner of finishing the sections in exact duplication of each other and spacing them correctly is shown in Fig. 9. This is sufficiently clear to be understood with a short description. The cam for raising the tool holder is fastened

to the planer by bolts at either end. The section of the mold marked "the work" is located squarely against the squared front of the cam; lengthwise and sideways against a stop. It is then clamped securely to the planer bed. The tool holder is now fastened in the tool post, the apron of which has first been set perfectly square with the planer bed. The forming tool is fastened within the holder—squaring it with the work by means of the two parallel edges *S S*, and allowing it to project out of the holder so the point of the cutting edge is 7-16 inch below the face of the roller, as in Fig. 9. The stroke of the planer bed is then set, the handwheel fastened on the feed screw, and the flopper clamped so that the end *K* will enter the notch in the handwheel, the back plate of the flopper being clamped to the upright side of the planer.



METHOD OF FINISHING THE MOULDS AND DUPLICATING THE CURVER TAPER ENDS.

Fig.9

PLANER SED.

Industrial Press

Everything is now ready. Starting from one side of the mold plate, the forming tool is moved over by revolving the handwheel a given number of times, and the indexing pall is dropped into the notch. The planer is then started and the forming tool fed down to the work. The tool cuts along straight until the roller *O* of the tool holder strikes the cam, when the tool is gradually raised, thereby cutting and finishing the mold at this end in exact duplication of the shape of the cam face. To gage the depth of the molds the tool is fed down until the straight edges *S S* of the tool touch the face of the mold plates. When the first mold is finished the tool is moved over the necessary distance by revolving the handwheel and indexing in the notch, and the operations are repeated until all twelve of the molds in the section plate are finished. The plate is then removed and another set up in the same manner and finished. The twenty section or mold plates are all finished in this manner, each one being an exact duplicate of the other, and all coinciding perfectly when put together.

The method used here for finishing these molds can be adapted for a large variety of different work, as will be at once seen, and the labor and expense incurred will not exceed that called into play if the work was done in the milling machine.

JOSEPH V. WOODWORTH.

* * *

GANG DIE FOR EYE-GLASS SPRINGS.

Editor MACHINERY:

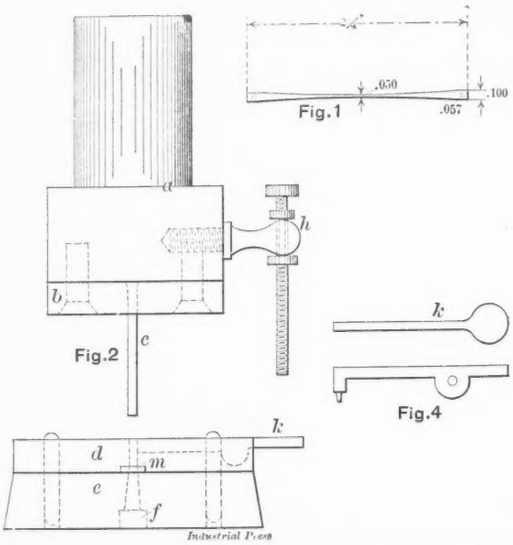
The die described herein does not differ materially from any other gang die, but on account of the frail punching, it requires particular care in constructing and might be of interest to tool-makers who have perhaps risked their chance of "a harp and a crown" while making one.

The cast-iron punch holder is shown at *a*, Fig. 2; *b* is the punch plate, made of machine steel; *c* is the blanking punch; *d* the stripper plate, which should be made of tool steel, and *e* is the die. A recess *f* in the bottom of the die is to lighten the burden of filing the shape of the blank; *g g*, Fig. 3, are the perforating punches; *h* shows the arrangement of releasing stop *k*, when the punch descends; *i i* are recesses in the bottom of the perforating holes in the die. Fig. 4 shows the stop for the stock, and *l*, Fig. 3, is a flat spring to hold the stop down; *m*, Fig. 2, is a slot in the stripper for the stock. Fig. 1 represents some of the punchings obtained, with dimensions as shown.

It is of the greatest importance that the blanks be of the required size, as they must fit into another part of the eye-glass very snugly, and must also be of a certain weight because they are punched from gold stock and even a slight variation would mean a considerable loss of gold, that is, if they be larger than necessary.

After the die blank has been coppered a sharp straight line is drawn through the center lengthwise and the shape of the blank, Fig. 1, laid out by means of the master blank. Now the stock is drilled out and every hole is reamed out with a taper reamer, as close to the outline as possible. The best kind of reamer for this sort of work is the home-made one of Stubs steel, with a taper of about .035 to the inch and filed away to the center line. These reamers cut freely and smoothly and have the advantage of being easily made. The shape is filed out next, the taper holes being used as guides. A taper drift may be used for the square ends, neat square corners being obtained by tapping the drift gently and filing away the bright spots until the line on the drift, indicating the desired size appears on the surface of the die. These drifts require but very little taper and do away with all guesswork. They will be found of special value in hexagon or similar shapes.

Now the perforating holes *i i* are drilled and reamed, particular care being taken to get them exactly in line with the blanking of the die, as the guide pins *n n* in *c* will mar the perforations if they are not. After the holes for the dowel pins, of which there should be four, have been drilled and the holes for the screws, also four, have been tapped, the die is ready for hardening. If heated slowly and equally it will come out of the bath quite straight. It is then drawn to a light straw. All these dies, of which about twelve of different shapes were made, contracted slightly in hardening, most of them about .001 and a few a little more. If they contracted more, they would have to be lapped out with a piece of brass and emery—which process invariably incites unlimited sympathy from your neighbor on a July day.



Now the punch *c* is made. It will be noticed that the holes for the guides pin *n n* are drilled all the way through the punch. This was found to be necessary because the punch broke at the guide pin holes every time the operator misplaced the stock, and *n n* did not enter the perforations whenever the holes were only drilled partly into *c*. It would also be impossible to get the guide pin out of the punch in case it broke off. Considerable trouble was experienced in hardening these punches, as they would warp more or less. They would have to be sprung into punch plate *b*, which proved to be a very dangerous and tedious operation, as too much springing caused the punch to break.

After a few of these punches had been treated in this manner, a different method was hit upon. Two strips of brass, ¼-inch x ½-inch, were dowelled together, the pins

riveted into one part and sliding in the other, and the punch was fitted between the two parts so that they would come together, gripping the punch slightly. Now the punch was heated, slipped into the jaws described and plunged into the water. In this manner of hardening three things are necessary: First of all, great speed; then the punch must be heated up as much as possible, since a great deal of heat is lost in gripping the punch; and it will also be found of importance to heat the jaws slightly before inserting the punch. A very small amount of cyanide of potash rubbed over the punch just before taking it out of the fire causes it to come out without any scale and with a dull silvery polish. It is then drawn over a Bunsen burner, leaving it blue at the back.

Next in order is the laying out of the punch plate *b*, which is done from the die. *b* is clamped onto *e* and the holes for *g g* are drilled right through the die. The punches *g g* are now made and fitted loosely, but without shake into *b*. *b* is again laid on top of the die, *g g* are inserted in their respective holes in the die, through *b* and the shape of the blank is scribed off from the die. After the punch has been fitted into *b*, it is riveted in the back. Now the punch plate is screwed and doweled onto the punch holder *a*.

Stripper plate *d* should be made of tool steel. It is screwed and doweled to the die and then taken off. Die *e* is now set in the press, in alignment with punch *c*, and the stripper plate put on the die again. The press is then lowered until the punch *c* touches *d*. The shape of the punch is now scribed off on *d* in sharp outline and the superfluous stock drilled out. The opening is next filed out to the outline as close as possible and the stripper again transferred to the die which remains set in the press. The ram of the press is brought down by hand, until the punch enters the stripper slightly. The stripper is then taken off again and filed out and this operation is repeated until the punch is through the stripper and enters the die.

After the holes for *g g* have been drilled and reamed through the back of the die, the slot *m* for the stock, as well as the slot for the stopper *K*, are milled or shaped out. Then stopper *K*, Fig. 4, is made.

This stopper, which is operated by screw *h*, should work

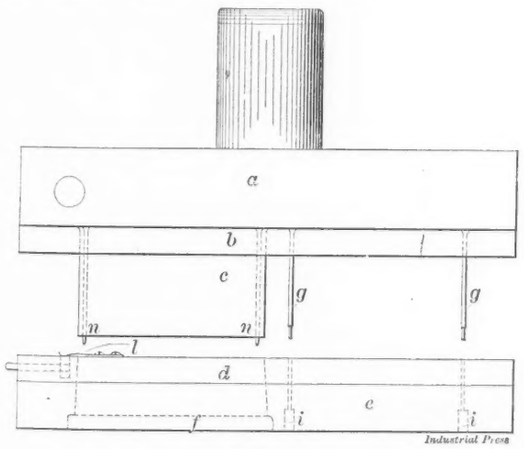


Fig. 3.

freely. The guide pins *n n* should be fitted into the punch so that they can be pulled out with a pair of pliers in case of breakage. In fitting the punch through the stripper, care should be taken to keep the edge of the punch sharp so that it will not spring over. The life of the die depends entirely upon a snug fit and perfect alignment of the stripper.

New York. FRANK GREINER.

* * *

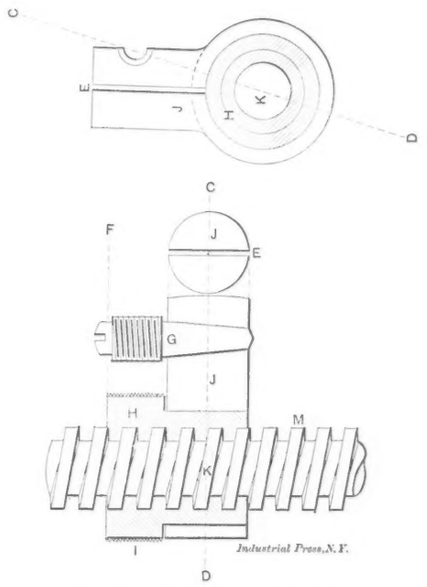
LOST MOTION IN LATHE CROSS-FEED SCREW.

Editor MACHINERY:

I enclose a sketch of a device for taking up the lost motion between the crossfeed screw and its nut on a lathe. This lost motion is often very troublesome when forming irregular-shaped pieces, and particularly in cutting a taper thread on a piece held in a chuck, if the lathe is not provided with a taper attachment. I have not had an opportunity to put this device to the test yet, but see no reason why it would not work, and will give it to the readers of MACHINERY for their consideration.

It consists of a bronze adjusting nut *H*, screwed on the end of the crossfeed screw *K* up to the stationary nut on the cross-slide which occupies the position *M*. The adjusting nut is clamped in position by tightening the taper pin *G*, which partially closes the slot *E* in the steel clamp J and holds the nut *H* by friction. The portion *I* of the nut is enlarged and knurled to make handy for adjustment by hand.

To attach to a lathe all that is necessary is to drill a hole in the cross slide, directly over the screw and close to the nut, the size of the upper position of the clamp *J*; and drill, tap and ream another for the taper pin *G*. If the cross slide



Method of Taking up Lost Motion.

is of such a design as to make it practical, I think it well to make the attachment of such a size that the end of the cross slide will come on line *F*. If the design is such that the pin cannot be put in this position, it may be put in from the top by threading the taper portion to prevent it from pushing the clamp downward. For ordinary use, the nut can be adjusted to the largest part of the screw; and for special jobs to the portion of the screw in use. The only tool needed to make the adjustment is a screw-driver or wrench, according as the pin is made with a slot or with a head.

Watervliet, N. Y. M. H. BALL.

* * *

FINISHING THIN CAST-IRON RINGS.

Editor MACHINERY:

A short time ago I had to make some cast iron rings 6¼ inches inside diameter, 7⅛ inches outside diameter and only 3-16 inch thick. It was necessary that the thickness should be uniform and the sides as straight as possible without grinding. I tried several ways of making them with varying success, generally poor. First I tried boring them out and then finishing them on an arbor; but they were so large and the arbor so heavy and cumbersome that it was impossible to drive them straight and, even if they were driven fairly straight, they had to be driven so hard to hold them for turning and squaring up that they would always be dished more or less when finished. Then I tried to finish them in the chuck but could not get them parallel and they would still be dished when finally taken out of the chuck. Next I tried making them from a large bushing, boring and turning them to size, and then cutting them off to thickness, but this did not prove to be very satisfactory either.

At last I hit upon a scheme which I think is original. At least, I have never heard of it before. First I made three clamps like Fig. 1. They were made of 1¼ x ¼ inch flat iron and were about 2 inches long, and were drilled and tapped for ½-inch bolts as shown in sketch. On one edge a hole was drilled and a piece of ⅛ inch steel wire driven in and left

projecting about ⅛ inch. I then took the castings for the rings, bored them out and faced up one side in the chuck, and drilled three holes in the edge of each ring, as at *A A A*, Fig. 2, large enough to receive the pins on the clamps.

The rings were clamped to the face plate with the finished side next to the plate and trued up by the inside of the ring. It will be seen from Fig. 3 that there were six slots in the face plate and in each of the slots not occupied by the clamps I bolted a small piece of iron to act as a stop to keep the ring

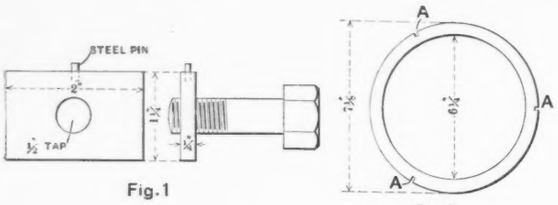


Fig.1

Fig.2

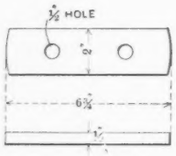


Fig.4

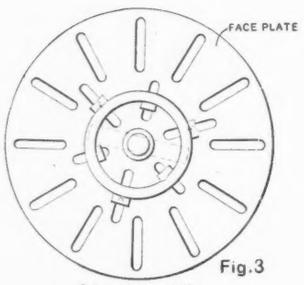


Fig.3

Industrial Press, N. Y.

from sliding on the plate while being faced. After it was faced, I put the clamp, Fig. 4, across the center, as shown in dotted lines in Fig. 3, holding it with two ½-inch tap bolts tapped into the face plate. This held the ring while turning off the outside diameter, after taking off the three small clamps and stops. I made quite a quantity of these rings in this way, with excellent results.

Fall River, Mass. FREDERIC E. DURFEE.

* * *

ANOTHER ANTI-FRICTION BEARING.

Editor MACHINERY:

In the article, "Anti-Friction Bearings," which appeared in the June issue of MACHINERY, I notice the writer mentions the moving of heavy machinery on rollers, such as short sections of pipe, etc., as an example of primitive anti-friction bearing. A scheme which I have used in house moving and for the annual transfer of the coal stove from the parlor to the woodshed, is equally as primitive but is a good thing to know when one has to move a heavy stove with very little help.

To use a plank and rollers to move a heavy coal stove is not an easy matter, and besides it requires nearly as much help as would be needed to pick the stove up bodily. What answers the purpose of an anti-friction bearing and allows a heavy stove to be easily moved by two persons is an ordinary broom. Tip the stove up on one edge of the base and thrust the brush of the broom under until it is squarely beneath the center of gravity. Now let one person steady the stove and another grasp the handle, and they will be surprised at the ease with which a heavy stove can be slid over carpets or bare floors. It is a little rough on the broom, but not nearly as harsh on it as the effect on one's back or fingers when attempting to carry a heavy stove bodily.

Hoboken, N. J. R. P. PERRY.

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PATTERN-MAKING KINK.

Editor MACHINERY:

Recently we required a number of small blocks to fit between the "fingers" of some grate bar patterns, and as the man who was working on the job hit upon a little kink which helped to shorten the time of doing the work, it may not be amiss to send a description of his method.

In Fig. 1 is a sketch showing the block, and in Fig. 2 the box that was used in planing it. It will be noticed that the sizes indicated in Fig. 1 call for a block 1⅛ inches thick by 2¼ inches wide, tapered to ⅞ inch at the bottom. Strips were sawn off the end of a board, each strip being 2¼ inches in the direction of the grain, and as long as the full width of the board, as indicated at the right in Fig. 1. The sides of these strips were then planed taper so that the lower edge would measure ⅞ inch thick and the upper edge 1⅛ inch, as indicated at the end view of this piece in Fig. 1. Blocks

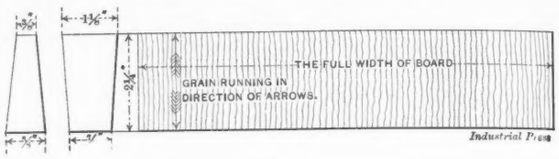


Fig. 1.

were then cut off from these strips of board a little larger than the size shown at the extreme left, Fig. 1, a miter box being used to obtain approximately the right taper.

For the final sizing a box was made as in Fig. 2, with the inside width to suit the width of the plane, and with thin strips fastened to the sides for the plane to slide on. These strips were adjusted so as to give the right taper to the

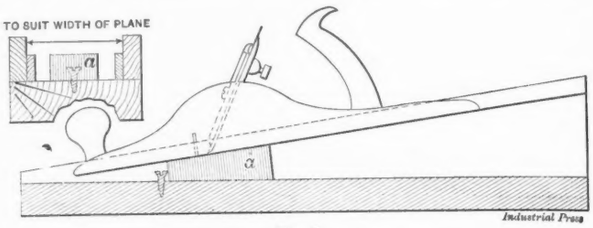


Fig. 2.

block *A* that was to be planed, and as these strips were very thin, the plane iron could not cut them away. Consequently by putting a suitable stop—a woodscrew if nothing better—to keep the block *A* in place, it could be planed to the correct size and taper. It should be mentioned that after planing one side of each block the stop must be moved to plane the other side to the thickness required.

Oneonta, N. Y. WM. NEWTON.

* * *

A GANG DIE.

Editor MACHINERY:

The writer has heard the statements made that gang dies do not pay; that they are too costly to make and keep in repair, are too difficult to set in the press and are liable to get out of order by the misuse of press hands. This may be true, in general, but I wish to submit a drawing and a sample of the work of a gang die that has successfully stood all tests that it should receive, and that costs, at the most, as little to make as the three dies necessary to do the work by single operations would have cost.

The purpose of this die is to make terminals for electric wires, which, after leaving the press completed, are dipped and the tubular parts filled with soft solder, ready to receive the wires.

The terminals are made from soft sheet copper, being punched from strips of the necessary width. The strip is entered into the die (Fig. 1) under the stripper *A*, and, resting on the part *C C*, is pushed in until it strikes against the pin *B*. In Fig. 1 *C C* is represented as being down to its lowest point, while *C'*, in Fig. 2, shows it in the normal position in which it is kept by the spiral spring shown under *B*, Fig. 1, being guided in its movement by the guide pins *F F* to keep it in position. The purpose of this part is to give a straight surface to slide the stock over more easily.

The pin *B* forms a temporary stop only, as will be explained later. The punch, in coming down upon the strip in this first position, blanks out the hole in the terminal and also shears out and raises the part, as shown at *R*, Fig. 6, that is later formed into a tube. This is done by the die *D* and the punch *E*, Fig. 1, which are both inverted from the usual position. A plunger, *G*, inside the die *D*, operated by a spring, is used for forcing out the metal which has been sheared out. The die is set, however, so that it does not cut the sheared metal

entirely off at this point, but, as may be seen at *R*, Fig. 6, leaves it projecting outward for the next operation.

The strip is then sent further in until the pin *B* will enter the hole previously punched, and then the second operation is performed, which consists of forming the part that is to be tubular into the form of an inverted letter U, as at *S*, Fig. 6. At *I*, Fig. 1, the punch is shown, and *H*, Fig. 3, shows the die for this operation.

The next operation forms the tube, as shown at *T*, Fig. 6, the punch for this operation being shown in Fig. 5, and at *K*, Fig. 1, and the die at *J*. The next stroke of the press is idle, as far as the particular section under consideration is concerned, since it is necessary to have an idle space in order to obtain room for the blanking die *L*. This blanking die is made of round steel, cupped out underneath for ease of construction on account of its peculiar shape.

After the first completed blank, as at *V*, Fig. 6, is obtained, the strip is stopped against *M*, Fig. 1, *B* requiring no further attention. The stop *M* is made adjustable, and the dies *L* and *N*, Fig. 3, removable, so as to be replaced by other dies, as there are two sizes of terminals made on this device. The punches corresponding to these dies are also made so as to be readily removable and others substituted. The various punches and dies are locked in their respective positions by pointed set-screws not shown.

J. R. GORDON.

Brooklyn, N. Y.

Fig. 3

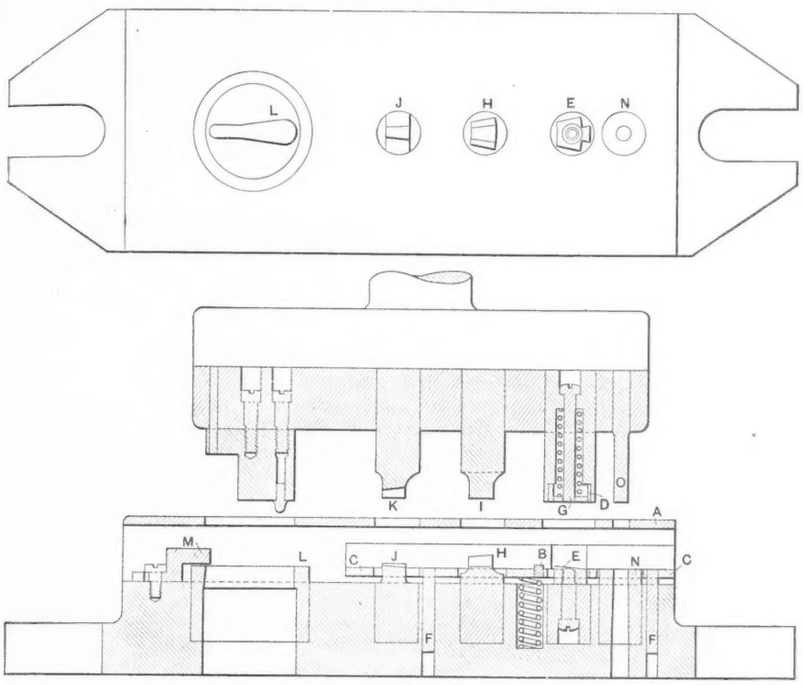


Fig. 1

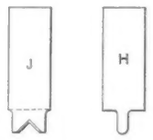


Fig. 5 Fig. 4

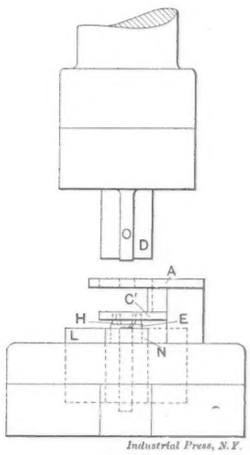


Fig. 2

Views showing Construction of Die.

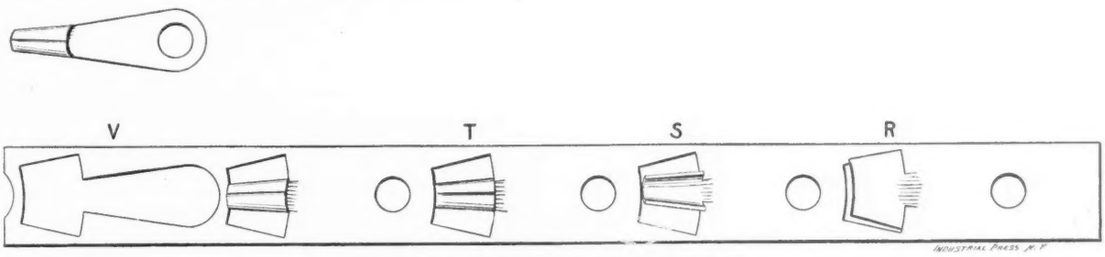


Fig. 6. View showing Sample of the Work Done.

* * *

SUPERANNUATED MACHINISTS.

Editor MACHINERY:

Somewhat remarkable statements concerning trade conditions in Chicago, and, by implication, in our whole country, appear in a report issued recently by the British Foreign Office, on education in the United States, by Vice-Consul Erskine.

In it it is stated that "the average age of the workmen in the big engineering plants is only thirty-two; that there are few men of forty-five who have not lost their speed, accuracy or sight, and that it does not pay a manufacturer to keep a man working on expensive machines, some costing as high as $10,000, if he is getting out only 90 per cent of their capacity."

Further, it is said to be now "a very hard matter for a man of thirty-five who is out of employment to get anything to do, for when a man has reached that age he should have been able, if a good business man, to have grasped some opportunity which must have presented itself and thus have acquired a business of his own, to have become an indispensable man to his employer, or to have passed his time of usefulness; while, on the other hand, if he is still capable of doing good work, it is to be suspected that he cannot have worked his hardest for twenty-five years, as he would then be worn out, and hence he is passed over for a younger man."

Now is all this true? Does a workman necessarily become superannuated—that is, useless—at thirty-two, or forty-two, or fifty-two, if he lives a proper life, in accordance with anything nearly like correct habits? Are gray hairs a certain sign of senility or dotage? Are "specs" the proof of incompetence or inability? Are years, in fact, a proper and positive bar to employment requiring manual dexterity, acquired skill and knowledge born of experience?

Why, then, if experience, or age, is no longer tolerable in our trade, where it has been presumed to have been specially required, are youth limits still allowed to be placed on our most prominent public servants and jurists?

Mature, ripened experience is still valuable and is so recognized notwithstanding our critic, whose source of information

and field of observation could not have been general or whose vision must have been perverted. So long as the prominent faculties of sight, either with, or without, the aid of "specs," hearing and touch remain ordinarily perfect, and no physical disability exists, it is contended that age, per se, is no detriment any more than it is a disgrace. But age in this sense depends not so much on years, but rather on how they have been lived. A man should be in his prime and in his best condition for employment between forty and fifty.

With trained mind, toughened muscles and experience in his trade, is he to be shelved and relegated to obscurity because he may not possess, or desire to emulate, the friskiness or agility of boyhood? We think not.

Our English friend rather confuses unwittingly his own statement with, or throws some light unexpectedly on, the condition of English mechanics, inasmuch as he states that " it is a hard matter for a man of thirty-five to get employment, even if capable of doing good work, as it is suspected that he cannot have worked his hardest for twenty-five years," etc. It would be strange if that had anything to do with present employment. By easy mental calculation, we find that such a condition would start the average man at his trade at the age of ten! Happily we don't do things that way in this country. Twenty is nearer an average age than ten for a young man to begin his mechanical life, so that we can, therefore, it is believed, reasonably add ten years to this assumed average age limit, making it fifty-five before he need apprehend serious danger of becoming superannuated.

Harrisburg, Pa. W. E. WILLIS.

* * *

HOW DID HE CUT IT?

Editor MACHINERY:

A rotary file with teeth on spirals, as shown in Fig. 1, is the problem. It puzzled a good many to know how it was cut. But it is simple enough when one knows the way, and a little study will solve the problem. The conditions to be met

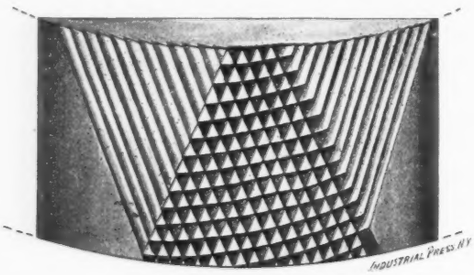


Fig. 1. Sketch of Rotary File.

were as follows: Approximate diameter, 3½ inches, and length 1⅜ inches, the angle of cut to be the same both ways and the depth of cut, practically the same both ways.

If the reader wishes to know how it was done, without studying it out, Fig. 2 furnishes the key to the solution. The lines *A-B* represent the directions of cut in one way, at the proper angle. In order to get the teeth on spirals, the intersections made by the cuts in the other direction with those in the first direction must come upon slanting lines, as at *C-D*. So draw lines, *E-F*, at the proper angles through the points of intersection of the lines, *A-B* and *C-D*. It will then be found that the spaces between the lines *A-B* are a little wider than the spaces between the lines *E-F*. Thus, by having a few more cuts one way than the other, and using an angular cutter best suited for the cut so that the depth will be practically the same both ways, a little trying will lead to the accomplishment of the job. The cuts were made as follows: Angular cuts, 21½ degrees in both directions; 124 cuts on one angle and 144 cuts on the other; 45 and 60 degree angular cutters used, and diameter of blank 3.469 inches.

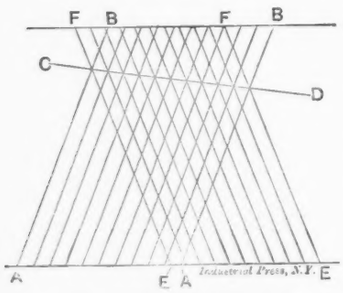


Fig. 2. Method of Cutting.

Providence, R. I. EDWIN C. THURSTON.

* * *

HOW AND WHY.

A DEPARTMENT INTENDED TO CONTAIN CORRECT ANSWERS TO PRACTICAL QUESTIONS OF GENERAL INTEREST.

Give all details and name and address. The latter are for our own convenience and will not be published

37. W. F. F.: Kindly inform me how to connect up a gas engine in a cheap way so that I could use gasoline to run it with? The engine is an upright, 1½ H. P., and has a cylinder 4 inches by 4 inches and hot tube to ignite.

A.—The cheapest plan is to purchase a vaporizer, of which there are several good ones on the market. The writer knows of a very simple device for this purpose which he has seen in use and which could be fitted up without much expense. Unfortunately, however, this device is an infringement on an existing patent.

38. A. L. N.: How is the angle calculated at which the work in a milling machine must be set in order to mill the four equal sides of a pyramid so that the included angle between the opposite corners shall be 60 degrees? For an example, take a lathe center turned to an included angle of 60 degrees which is to have its sides milled off, leaving the corners at the original angle of 60 degrees. What will be the angular setting and how is it calculated?

A.—Fig. 1 shows the square *M D K L* (the base of the pyramid) inscribed in a circle. That is, it is drawn so that its angles coincide with the circumference. The length of one side of the square or *D K* will be the angular divergence of the two opposite sides *M D* and *L K*, in the height of the pyramid. One-half *D K* or *D E* will be the angular divergence of any one side to the center line *A B*. Taking the radius of the circle to be 1, then from the familiar proposition for right-angled triangles we know that $\overline{DE}^2 + \overline{EC}^2 = \overline{DC}^2 = 1$ But *DE* and *EC* are equal, so $2\,\overline{DE}^2 = 1$, $\overline{DE}^2 = .5$ and $DE = .7071$ (the square root of .5). Dividing .7071 by the length of the perpendicular height *CB*, Fig. 2, which in this case is 1.732, the

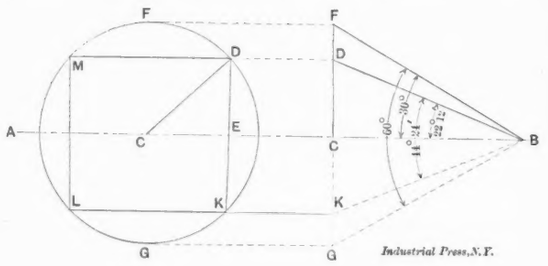


Fig. 1. Fig. 2.

result .4082 is the tangent of the angle *DBC* or 22° 12′, as found in a table of natural tangents. The included angle *D B K* is, of course, 2 times as much, or 44° 24′. From this we deduce the following rule: Multiply the radius of the circle in which the base of the pyramid is to be inscribed, by .7071 and divide the result by its perpendicular height. The quotient will be the tangent of one-half the included angle between two opposite sides of the required pyramid. It is obvious that a table of angular settings having been once computed for the various angles likely to be used, they may be employed without reference to the size of the circle in which the base is inscribed or to the height of the required pyramid.

39. G. E. A.: 1. What are the standard diameters and pitches of threads for the hose ends of bib-cocks and faucets? 2. What is the standard taper for pipe taps and dies?

A.—1. Inquiry put to a manufacturer of this class of goods elicits the information that there is no recognized standard for the hose fittings on bib-cocks. Each manufacturer has his own standard for the various sizes. The size which is nearest standard is that for the ¾-inch garden hose so generally used, but even in this there are makes that will not interchange. 2. The standard taper for pipe taps and dies for pipe threading is ¾ inch per foot.

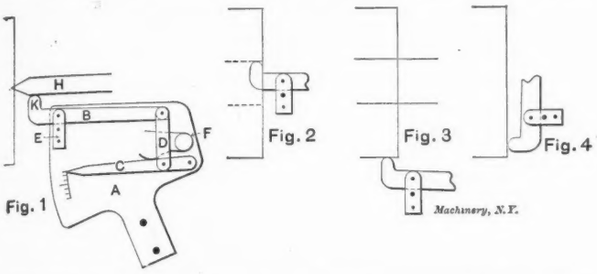
SHOP KINKS.

A DEPARTMENT OF PRACTICAL IDEAS FOR THE SHOP
Contributions of kinks, devices and methods of doing work are solicited for this column. Write on one side of the paper only and send sketches when necessary.

TEST INDICATOR.

Maynard Long, Geneva, N. Y., describes a test indicator:

"Referring to the sketches, Fig. 1 shows the indicator applied to truing up a prick-punch mark or small hole. The round bar *H* is about six inches long, and is supported at the other end by the tail center, which is always in line, hence no loosening of bar, a feature that is not always provided for in center indicators. *A* is a piece of sheet metal upon which are



mounted the levers *B* and *C*. *D* is a connecting bar between, and lies on top of *B* and *C*, giving room for the light spring *F* underneath. *E* is riveted to *A*, and is bent to go on top of *B* to make a substantial joint. The connections are so made that 1-1000" on point *K* makes the pointer travel one degree or about 1-32". I find this none too sensitive to do accurate work. *A* is riveted to a short piece of 5-16" round stock, which can be used in the tool post on a bench lathe or a boring tool holder.

"Fig. 2 shows its application for a larger hole or ring, Fig. 3 for outside truing, and Fig. 4 for side truing. In graduating the indicator piece *A* was clamped to a plate, as was also a micrometer with the live spindle against point *K*. Thus I know the indicator reads correctly, and I find it very convenient to know how much the work is out of true."

MAKING STEEL COLLARS.

Arthur Munch, St. Paul, Minn., says: "The sketch shows how I made quite a number of steel collars which were used on a guide plate for boring flue holes in boiler plates. This way of doing saved quite a little time over drilling away all the metal on the inside of the collars. The sketch clearly

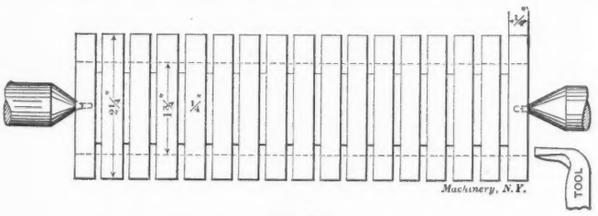


Fig. 5.

shows how it was done. The tool was fed along at a fine feed, boring the collar nearly to size. After the collars were bored off they were chucked and bored to the exact size. I presume this is nothing very new, although I have never seen a job done like it or illustrated in MACHINERY."

PLANING THE WINDOWS OF ROLLING MILL HOUSINGS.

The accompanying cut shows how the "windows" of rolling mill housings are planed out at the works of the Philadelphia Roll and Machine Company, Philadelphia, Pa., on an old Hetherington & Co.'s 60" x 60" x 22' planer. As will be seen from the relative proportions of the planer and the rolling mill housing, the job is one that is far beyond the normal capacity of the planer. As the planer is arranged, however, it shows a greater efficiency than some portable tools specially designed for such work, doing this particular job in less than one-half the time required by some competitors. The windows of the housings have to be machined wherever the finish mark is indicated. Both sides and the bottom of the window are planed at one setting by reversing the position of the tool head to that indicated by the dotted lines, or to right angles, as required.

The housing is "squared" up on the planer platen, on edge, resting on parallel blocks. Two angle plates, *B B*, are set behind the housing to hold it and take the thrust of the planer tool. The tool apron is mounted on an extension which advances it beyond the normal position about 18 inches, or far enough to pass through the window without the housing

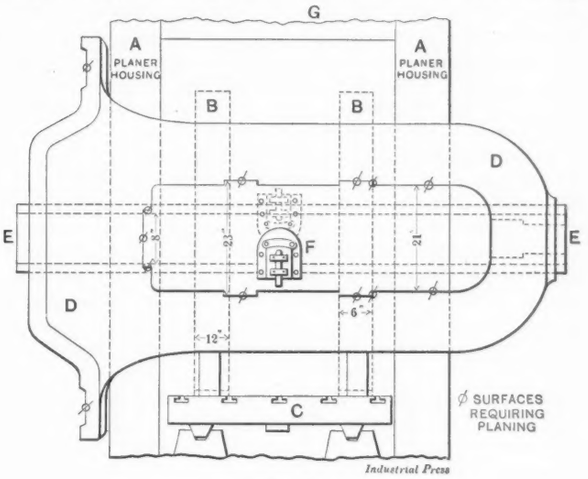


Fig. 6.

striking the crossrail of the planer. The feature of the crossrail and tool apron which allows the tool to operate in either position means a large saving in time over that which would be required if the housing had to be reversed to finish both sides of the window.

In the cut, *A A* are the planer housings; *B B* are the angle plates for holding the work in position; *D* is the housing to be planed; *F* is the reversible tool head; and *E* is the crossrail of the planer.

BORING TOOL FOR MARINE ENGINE CROSSHEADS.

Fred Harrison, Philadelphia, Pa., describes a boring cutter for roughing out the piston rod hole in marine crossheads. The crossheads are of very hard steel, and it requires five and one-half hours' time of an apprentice to bore out one hole. The diameter of the crossheads is 10 inches, and the diameters of the taper hole are 5 and 4⅝ inches. First a 2-inch hole is drilled through the crosshead, and then the

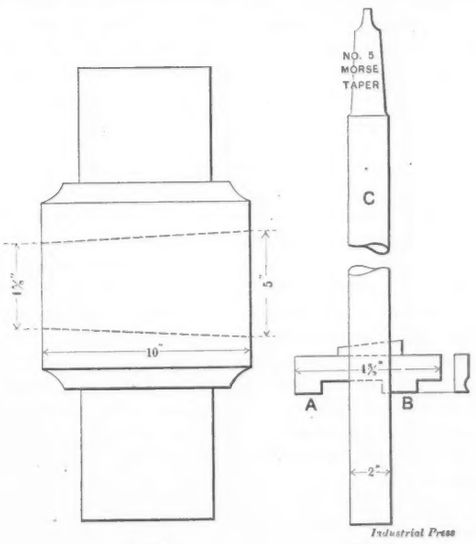


Fig. 7. Fig. 8.

stock is removed to the 4⅝-inch diameter by the boring bar, *C*, carrying the double-ended cutter shown. It will be observed that this cutter has two cutting lips, *A* and *B*, which remove the stock in concentric circles and thus divide up the work on opposite sides of the bar. The cutters are made of 2" x ½" steel. After the stock has been removed, the taper hole is finished on a boring mill.

NOTES ON ERECTING SUGAR MACHINERY.

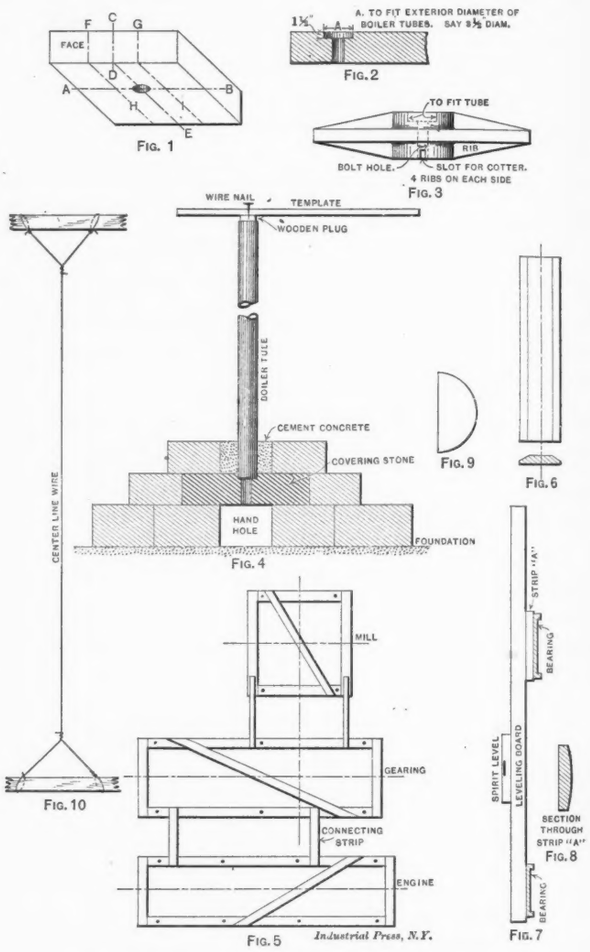
THE METHODS EMPLOYED IN BUILDING THE FOUNDATION AND ERECTING THE APPARATUS.

It has struck me that the above subject may form an interesting article, and be instructive to the younger members of our business. When I was a young man first starting engineering on my own hook, I would have been only too glad to have been given a few hints on erecting machinery, and I hope the following may prove useful to others. Localities, of course, alter conditions. For instance, in some places, large stones cannot be procured; then too, sugar machinery is not to be erected everywhere. The general principle, however, is the same in the erection of all machinery.

The first thing to be considered is the foundation. It must be substantial, and ample increase of area must be allowed at the bottom of the foundation for stability. The depth depends on the nature of the ground and the weight of the plant to be erected; in some localities it is even necessary to drive piles. The "modus operandi" is as follows: For the bottom, or first course, roll into the hole, which has previously been dug, the largest stones that can be handled. Place them a short distance apart and fill in the interstices with good lime concrete, well rammed in, composed of, say, one part lime, three parts sharp sand, and four parts broken stones that will pass through a 2½-inch mesh. The remaining depth of the foundation is to be completed with rather a stronger concrete of, say, two parts lime, three sharp sand, and five parts broken stones that will pass through a 1½-inch mesh, well rammed in, being always careful to see that too much water is not used with the concrete. The large stones should be well watered before the first course of concrete is thrown in, and the top course must be made quite level, and plastered with fine mortar. Set out the first center line parallel with one of the walls of the building that is to contain the machinery and the first right-angle center line by trammels, and not with an ordinary mason's square, since you are more likely to get the work accurate. When all the center lines have been drawn, proceed with the lines for the foundation walls, hand-holes, etc. When the work has been laid out, go over it again to be certain that there is no mistake; if it is correct, drive wire nails in the centers for all bolt-holes and at the end of the main center lines, so that they may easily be found if rubbed out. If the scribes are not taken up, on the first day, the lines can be covered with boards weighted with stones, or with bricks. After the first course has been laid, generally 12 inches high, fix the covering stones, Fig. 1, on the hand-holes by their scribes previously drawn. To prepare the covering stones for the hand-holes, let the stone be as large as possible, say not less than 2 feet 6 inches long by 2 feet wide by 8 inches thick. Cut them square and parallel on all sides except the side opposite the face, as that does not matter very much. Find out from the drawing that the markers of the machinery supply for building the foundation walls, the distance the bolt-holes should be from the face of the stone and scribe a center line, *A B*, that distance from the face, across the top and bottom, parallel to the face. Then bisect the stone and draw center lines *C D* and *D E* at the bottom and front faces. Set off the width of the hand-holes *F G* and *H I*, which serve to set the covering stones accurately over the hand-holes. A cross section of the covering stones, Fig. 2, shows how the bolt-holes are to be drilled, and also the hole for a boiler tube, the use of which I will explain hereafter. Sometimes hard wood timbers are used instead of stone, but in damp localities they decay and cause considerable expense for renewals. If good stones are not obtainable, cast-iron covering pieces could be made like Fig. 3.

Next, find out from the foundation drawing the height from the tops of the covering stones of the hand-holes to the under side of the bed plate, and cut off as many good second-hand boiler tubes as there are holding-down bolts required to this length, plus the depth of the tube hole, Fig. 2, or 1½ inches, minus ¼ inch for clearance, and minus the thickness of the timbers between the walls and bed plate. I generally use large stones carefully dressed, or concrete, instead of timbers, which latter plan I will explain in its proper place.

After the hand-hole covering stones have all been laid, preferably in Portland cement, build one course of stones above them, leaving a space of about 6 inches all around each bolt-hole. Insert the boiler tubes in their places, having previously fitted a wooden plug in the top end of each tube, the plugs having a small hole bored accurately in their centers, say 1 inch deep, Fig. 4. Have six straight laths made about 6 inches wide, two for the mill, two for the gearing, and two for the engine. Mark a center line on each and mark off the distances of the bolt-holes on the center lines, and then bore small holes in each bolt-hole, being careful to keep the gimlet plumb. Nail a strip at the end of each pair of laths, being very particular to get the bolt-holes in each opposite to each other, and that the center lines are parallel and the correct distance apart. When this is finished, nail a piece of board diagonally across to prevent the template, Fig. 5, from getting out of truth. Fix the tubes plumb, put the templates on top of them and drive wire nails through each hole into the hole in the plugs; then proceed to fill the 6 inch space around the tubes, Fig. 4,



Sketches Illustrating the Erection of Sugar Machinery.

in the first course above the covering stones with cement concrete, which will keep the tubes plumb and rigid. Then the wall can be finished and pointed with Portland cement mixed with sand in the proportion of one part of cement to two parts of sand.

When the first set of tubes has been built in, you can proceed with the next lot in the same way as the first, being careful to see that the templates are the correct distance apart and always remembering to work from center lines. The templates should be attached to each other by strips, as shown in Fig. 5. When all the walls have been brought to a proper height, remove the templates and put on the timbers, or the top course of stones, with cement mortar, being extra careful to see that they are level and true. When cured, lift on the bed plates and true them up by their center lines marked on each bed by the manufacturer. The distance apart of the beds will be given by the foundation drawing. Level the beds with a good

long spirit level on their planed surfaces. A plan that is cheaper, and, for light machinery, quite as good, is to build the walls within 1½ or 2 inches of the proper height and level and square the beds on iron wedges at the corners. When true and level, screw them down on the wedges and fix boards on the inside of the beds and ram cement concrete between the beds and foundation walls, removing the wedges when the work is cured, filling the spaces left by the wedges with concrete. This concrete must be made with very small hard stones, about ½ inch square. Should the beds be cast open at the bottom, they can be filled with cement concrete before being lifted on. If possible it is always advisable to have drain holes between all the walls, and also to any lower ground that may be near by. This prevents water from being retained in the foundation, which must of necessity do harm.

When laying the first, or bottom course, the second-hand boiler tubes can be put down in Portland cement, so that, even when the tube rusts away, the hole will remain intact. Fix all the plummer-blocks approximately in their places, with their bottom bearings in their places or seats, and also put on the two mill standards, or checks, with the bottom bearings of the top rolls. Make parallel pieces of board of the same width as the diameter of the journals, about 2 feet or 2 feet 6 inches long and beveled on the under side, as shown in Fig. 6. Bisect them and draw a pencil line accurately down the center of each and fix them in the bearings, being careful to make them level with the top of the bearing. Then stretch a center line or fine wire over the boards in its correct position and move the center-line blocks until the pencil lines are under the center line. Should the blocks be slightly out of true, or, in other words, twisted, the defect will be exaggerated on account of the parallel boards being so much longer than the bearing. Lift on the crankshaft and stretch a center line through the center of the cylinder, if a horizontal engine, and the scribe on the crank end of the engine bed, which is always put there when the engine is being made. Then put the crank on the two dead centers and see if the center line cuts the crank pin equally in two. If it is a beam engine, then work to the center line on beds. Level on the bearings carefully with a parallel rod, not less than 4 inches wide, made out of well cured pitch or white pine board, free from knots. Loose strips the length of the bearings must be placed between the leveling rod and bearings when there is a difference in the size of the journals, Fig. 7. The bottom side of the strip must be rounded off to fit the bottom of the bearings, Fig. 8. The thickness of the strips is obtained by taking the diameter of the journals and making them half the difference. Be very careful that the straight-edge seats home on the strips and the strips rest solidly on bearings—that is, see that the bearings are level. The strips should be taken out and the bearings, etc., tried with the spirit level. Another way is to make half-round templates out of thin sheet iron and level on top of them, Fig. 9. When screwing down the bed plates keep the spirit level on all the time, trying both lengthways and across.

When the bedplates have been screwed down, have thin stones cut to fit the hand-holes and put them in with Portland cement. This keeps the keys, holding-down bolts, etc., free from damp in the case of water getting in the foundations. In stretching center lines or wires, my practice is to tie one end of the line a little to the left and the other a little to the right of its final position, and overhand it with a piece of twine, attached about 1 foot from the ends, Fig. 10, until I get it correct. This saves no end of time.—*E. Y. C., in Steam Engineering.*

* * *

ELECTRIC ELEVATOR IN THE WASHINGTON MONUMENT.

In overhauling the elevator plant of the Washington Monument, it has been thoroughly modernized by the installation in it of an electric elevator, which has the distinction of being the highest single-lift electric elevator ever built. The old elevator was operated by steam, but its mechanism has been replaced by a machine built by the Marine Engine & Machine Co., New York, a company rather new in electric elevator work. The elevator machine has a novel gearing between the drum and motor shafts, consisting of a right- and a left-hand spiral gear on the drum shafts meshing with a right- and a left-hand worm on the motor shaft, which arrangement offers the advantages of the worm and gear, and at the same time neutralizes the attendant thrusts therefrom. The worms are a solid part of the high-carbon, hammered-steel worm shaft, while the spiral gears are of high-grade bronze, accurately cut and bolted to cast-iron spiders. The driving gear shaft is also of high-carbon, hammered-steel, with flanges forged on, to which the driving gear spider is bolted with reamed coupling bolts. The motor and gear frames are bolted to a solid common bed-plate, which surmounts a heavy brick pier faced with white enameled brick.

The reduction gearing reduces the speed from the motor to the drum in the ratio of about 21 to 1, and the drum gearing is so adjusted that when the motor is operating at its maximum speed, the elevator car travels at a rate of 100 feet per minute. The car is overbalanced by 4,000 pounds when empty, the counterweight weighing 8,000 pounds; and the maximum load capacity of the car is 6,000 pounds.

The car weighs about 4,000 pounds, having a carrying capacity of 35 passengers, and is decorated with bronze- and wrought-iron work, handsomely executed in design, and plate mirrors. Special safety devices are provided, in addition to the automatic high and low limit stops, which will stop the car within six feet of travel after their release, even when it is fully loaded.

For power for the electric motor, the boiler house for the old steam elevator was remodeled, and slightly enlarged to receive an engine and dynamo which furnishes the electric current. A duplex compound engine, made by the American Engine Co., Bound Brook, N. J., was installed, directly connected to a Crocker-Wheeler multipolar dynamo of 50 kilowatt capacity at 240 volts. The power plant is arranged in the most approved manner, and all fixtures are of the most substantial character, the steam piping being of the best quality. A two-panel switchboard containing necessary fixtures for both generator and feeder panels and very handsomely designed, is provided, and is so connected that in case of any mishap to the plant, power may be switched in from the local power company.

From the feeder panel, two circuits are led through the tunnel, formerly used for steam pipes, to the elevator motor and lighting circuits in the monument, being controlled at the monument in an underground room near the base by local switchboards. One of these switchboards controls the lighting of the monument only, and the other, the elevator motor, containing the solenoid resistance regulator, "speed" relay, circuit-breakers, etc., necessary for the control of the motor from the car.

The elevator has been in use for some time and operates very successfully, requiring only five minutes to rise through its 498 feet of travel, and is under full control at all times.

* * *

As an example of the founders' art the cast iron chilled carwheel is undoubtedly without a peer among all other classes of cast-iron work when all the conditions necessary to its success are considered. A carwheel must stand certain prescribed tests formulated by the Master Mechanics' Association in order to be accepted by the railroad purchasing agents. One wheel from each one hundred wheels must be subjected to the drop test, in which a certain weight falling from a height is allowed to strike the hub of the wheel while the rim is supported on three points. Another wheel is subjected to the thermal test, which is performed by bedding the wheel in molding sand, leaving a space around the tread and pouring molten iron around it. The result is that the outer portion is suddenly expanded, and, unless of the best grade of metal, the wheel flies to pieces. The first test is to try the wheel for its ability to stand the shocks of service and the thermal test is to determine its ability to stand long continued brake shoe pressure, as is necessary on long grades. Carwheels also have to meet certain requirements as to depth and quality of the chilled tread. After meeting all these requirements, the carwheel maker is enabled to command a price for standard wheels of only about one cent per pound, making the average price per wheel from $6 to $7.

NEW TOOLS OF THE MONTH.

Under this heading are listed new machine and small tools when they are brought out. No tools or appliances are described unless they are strictly new and no descriptions are inserted for advertising considerations. Manufacturers will find it to their advantage to notify us when they bring out new products, so that they may be represented in this department.

The Newton Machine Tool Works, Philadelphia, Pa., have produced a new special tool in the way of a vertical spindle rotary milling machine, having a direct-connected electric motor drive. It has a cutter 30 inches in diameter and the table has a travel of 6 feet. The motor drives the machine through a raw hide pinion and gear, and a train of spiral and spur gearing.

A novel independently driven lathe has been brought out by Schumacher & Boye, Cincinnati, O. It is called by them a self-contained lathe, as the electric motor is located on the frame and requires no countershaft. The motion of the motor is communicated to the spindle through friction disks, and a system of gears and a belt, a double clutch in the gears permitting reversal of motion at the spindle. The speed of the machine is varied by varying the relation of the friction disks, instead of the usual manner by controlling the motor.

A novel application of the electric motor to independently-driven tools has been made by the W. F. & John Barnes Co., Rockford, Ill., in the application of a direct motor drive to their water emery grinder. The motor is placed on top of the emery wheel case where it is out of the way and not liable to injury or dirt. It drives the emery wheel directly by belt, and is controlled by a knife switch and starting box conveniently located on the frame below the table. This is a particularly adaptable application of the electric motor on account of the similarity of speeds and consequent economy of transmission.

BECKER-BRAINARD CUTTER GRINDER.

The illustrations, Figs. 1, 2 and 3, show a cutter grinder recently brought out by the Becker-Brainard Milling Machine Co., Hyde Park, Mass., one of the first machines built being now exhibited at Buffalo. It is designed primarily for grinding the cutters used in the Becker vertical milling machine, but can also be used on the milling machine as a fixture for milling cutters of certain shapes that cannot be produced easily on the milling machine without a special fixture. When used for grinding it rests on a stand or bench and a special countershaft is provided for driving it.

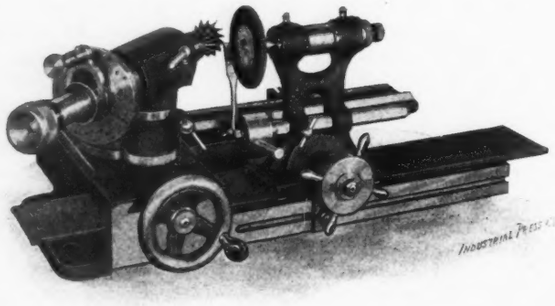


Fig. 1.

At the front of the grinder are ways running longitudinally for supporting the head carrying the emery wheel. The ways are protected from dust and emery particles by a shield. At the left of the base, and at right angles to the front ways, are ways carrying the head supporting the cutter, as shown in Figs. 1 and 2. In Fig. 3 this same head that is used as a cutter support in Figs. 1 and 2, is arranged with a small cone pulley and a center for driving and supporting a milling cutter that it is necessary to grind on centers. The tail center for the support of the cutter consists of a small tail stock mounted on another pair of longitudinal ways at the back of the machine. The wheel that does the grinding is supported and driven in the same manner as in the previous cases.

A feature of the machine is the way in which the head that supports the cutters is made to swivel. The bracket that supports it is, first of all, pivoted on the cross slide and an arm or bracket extends a few inches to one side of the pivotal point where it supports the head and at which point

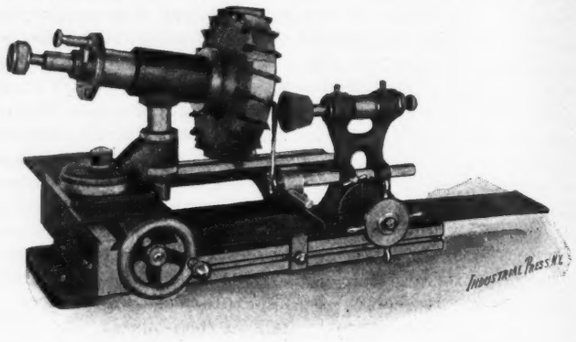


Fig. 2.

the head itself swivels on the arm. The head has its own indexing device and the swiveling arrangement is such that the cutters can be brought into any desired relation to the wheel, making it a simple matter to grind beveled cutters. Fig. 2 shows a special head for supporting face mills.

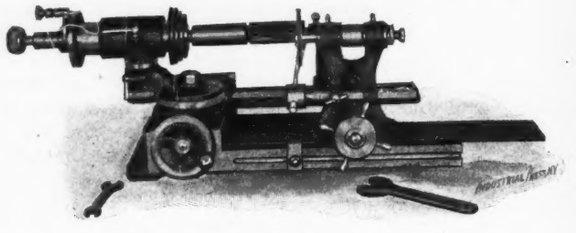


Fig. 3.

Cylindrically shaped cutters are easily milled by using this fixture on the milling machine. The swiveling head can be made to act on the principle of a ball turning device and the cylindrical teeth milled in this way. After that they can be ground in a similar manner.

RIVETING MACHINE.

A new model of riveting machine of the rotary blow type has been brought out by the F. B. Shuster Co., New Haven, Conn. In this machine, shown in Fig. 4, the power is applied directly and centrally to the oscillating cylinder which drives the hammer rod. The cylinder has a large guiding surface and moves freely so that by the combination of the rebound of compression springs and the direct drive, a large increase of speed over their old model is permitted. The hammer rod is given a positive rotating motion by means of a worm and gear attachment, so that the hammer creates an evenly applied breaking-down action and forms an evenly-shaped head on the rivet. This type of riveter is made in sizes ranging from 1-16 inch to ¾-inch sizes.

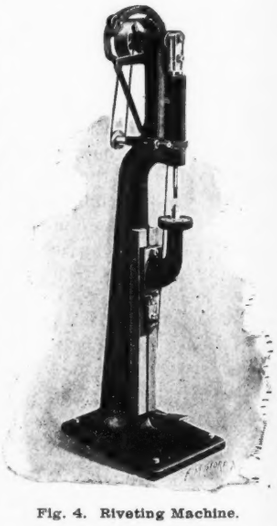


Fig. 4. Riveting Machine.

NEW WIRE GAGE, SCREW-THREAD GAGE, AND RULE WITH SLIDE.

The Brown & Sharpe Mfg. Co., Providence, R. I., have recently placed upon the market a Washburn & Moen standard wire gage, an improved 29° screw-thread gage, and a 6-inch rule with a slide. The Washburn & Moen standard wire gage is a wire gage of the familiar circular pattern, and is made of steel, tempered and carefully adjusted after hardening in

the usual way. It was brought out to meet the demand of wire manufacturers and sheet metal rollers using the Washburn & Moen standards of size.

The 29° screw-thread gage, illustrated in Fig. 5, is a decided improvement over their old form of circular gage with auxiliary setting gage. In the new form the gage proper and setting gage are combined in one and a new feature in the way of a 29 degree angle slot for setting tools irrespective of the pitch is inserted in one end. The shape of the new gage allows easy setting of the tool, and also has permitted the

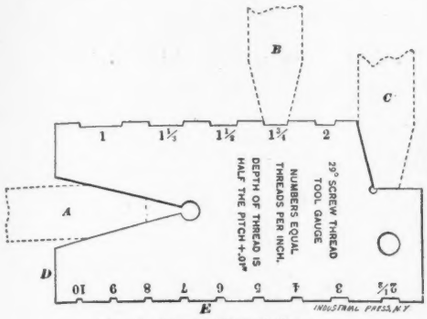


Fig. 5. Screw Thread Gage.

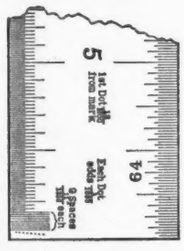


Fig. 6.

addition of three pitches not given on former gages. The gage is of steel, tempered and adjusted after hardening in the usual manner.

The 6-inch rule with slide is designed for convenience in measuring against shoulders and the widths of flanges, collars, etc. Fig. 7 shows the rule with the slide in position. The slide, which is held in position by a tongue fitting into a groove on the side of the rule, may be removed, if desired, allowing the rule to be used in the ordinary way, or it may be reversed to the other side. The rule is furnished in their Nos. 1, 2, 4 and 7 standard graduations.

Fig. 7. Rule with Slide.

The improvements in the standard Brown & Sharpe steel rules possess some especial advantages for fine work. Fig. 6 shows the new arrangement of graduating these rules whereby measurements may be obtained to thousandths of an inch. It consists of 10 lines marked near the end of the scale with spaces 11-1000 each, and beyond them an inclined row of dots, each of which is 1-1000 inch farther away from the line. By properly setting dividers upon these combinations any measurement to thousandths may be obtained.

SCREW PITCH GAGE.

The Sawyer Tool Co., Fitchburg, Mass., have placed on the market an improved screw pitch gage which is shown in Fig. 8. It consists of a series of blades with the pitches cut on their edges, which blades fold up into a case, making it a very compact pocket tool. The blades are made narrow and tapering to allow them to enter and gage a comparatively small nut, as well as gage threads in narrow, confined quarters. For the finer pitches the blades are graduated on both edges, only nine of the larger sizes being cut singly to a blade, which reduces the bulk of the tool nearly one-half. It has a range of 39 pitches, from 4 down to 60.

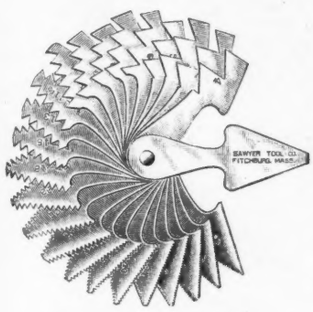


Fig. 8. Screw Pitch Gage.

NUT FACER.

A novel machine has been placed upon the market by the Detrick and Harvey Machine Co., Baltimore, Md., in the way of a nut facer, shown in Fig. 9, for facing and chamfering finished nuts. The nuts are run on and off the threaded mandrel by the machine and it is impossible to use either a wrench or hammer upon them, thus eliminating any danger of marring the nuts or springing the mandrel. The cutter, instead of being composed of several separate tools, is a single

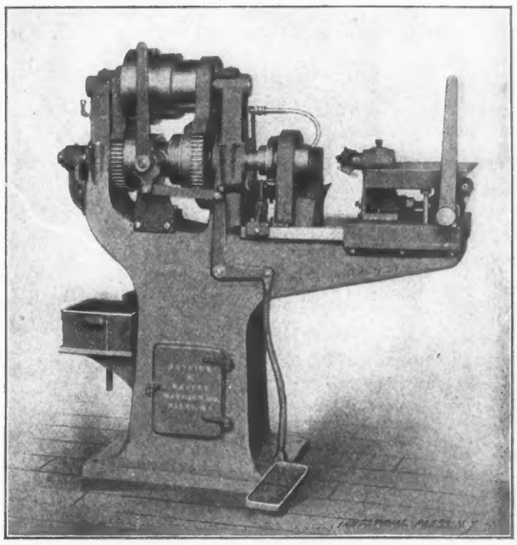


Fig. 9. Detrick & Harvey Nut Facer.

formed cutter head which may be sharpened without altering the shape of the cut, and thus the entire operation of facing and chamfering, which includes chamfering the first thread, is done by a single forward motion of the carriage. In this

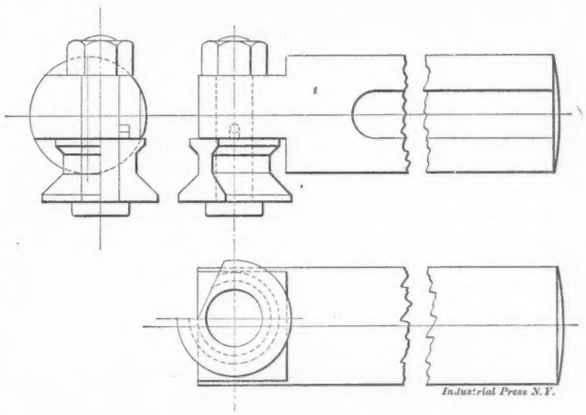


Fig. 10. Cutter for Nut Facer.

way, and by aid of an oil pump to flood the work for high cutting speeds, rapid work may be done. The No. 1 machine has a range of 1¼-inch nuts and under, and the No. 2 of 2-inch nuts and under.

VERTICAL TURRET MACHINE AND MANUFACTURING MILLING MACHINE.

Warner & Swasey, Cleveland, Ohio, have recently brought out a new design of their vertical turret machine embodying some important improvements over the old type, and in which the capacity is considerably increased. A side view of the new machine is given in Fig. 11. It is especially adapted for boring, facing and turning a large range of work, having a capacity of swinging work fully 30 inches in diameter and 22 inches under the cross slide. The entire cross slide is capable of vertical adjustment through nine inches, by means of the large hand wheel at the back, which materially increases the range of the machine over simply the cross slide and turret slide adjustments. The cross slide and the turret slide are both arranged for either hand feed, or power feed at eight different speeds by a novel gear arrangement, and these feeds may be reversed or thrown in or out by a lever. The change from cross to vertical feed is also made by a lever, and adjustable automatic stops and also fixed limit stops are provided which will throw off the power feed, in any case, at the end of the slide. The chuck is driven by a vertical pinion meshing with a large gear cast solid with the spindle.

and the driving pinion is so set as to bring the line of gear centers directly under the line of travel of the cutting tool, thus preventing any torsional strain in the spindle.

Fig. 12 shows a view of their No. 2 manufacturing milling machine. It has a range of 2½ to 7½ inches distance from spindle center to top of table and will swing a cutter 6 inches

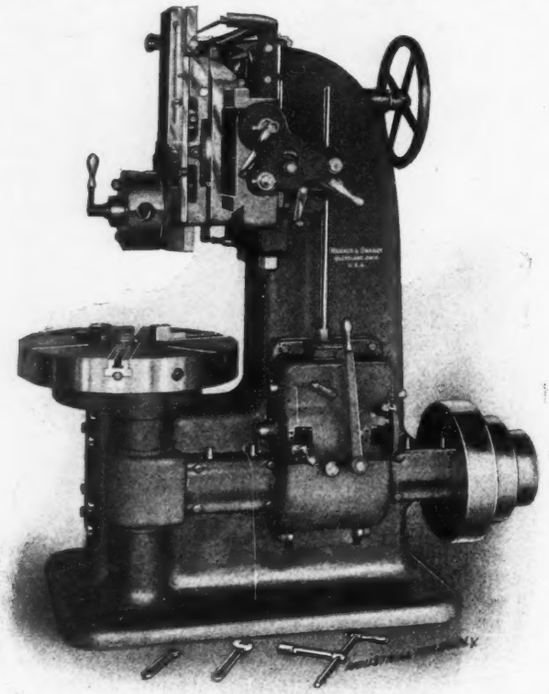


Fig. 11. Vertical Turret Machine

in diameter. The head carrying the spindle is pivoted at the back to the frame of the machine and provision is made at the front whereby it may be clamped firmly there, thus procuring rigidity for it in its different positions. The spindle drive consists of gearing concentric with the pivot about which the head turns, so that the spindle is in gear at all positions of the head. The overhanging arm is heavy and has an out-

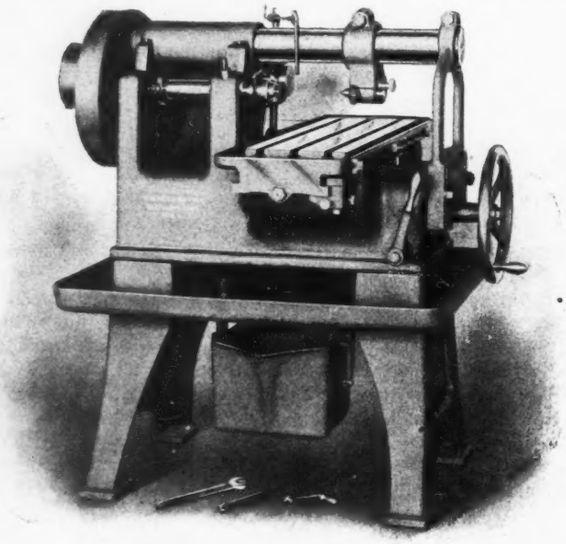


Fig. 12. Manufacturing Milling Machine.

ward support consisting of a slotted yoke which may be clamped rigidly to the bed in any position. The table has a working surface of 26 by 8½ inches and the automatic feed, which is gear-driven, has three changes which may be made without stopping. Adjustable automatic trips are placed on the edge of the table to disengage the feed. An oil pump is furnished, with drain-pan and reservoir, for flushing the work with oil when necessary. Both of these machines are on exhibition at the Pan-American Exposition at the Warner & Swasey exhibit.

HAND YOKE PNEUMATIC RIVETER AND DRILL YOKE.

The Standard Pneumatic Tool Co., Chicago, Ill., have brought out a hand riveting yoke for use with their "Little Giant" pneumatic hammer. Fig. 13 is a view of it in connection with a No. 1 riveting hammer at work on hopper riveting work. It has a pneumatic "hold-on" which is an air cylinder for

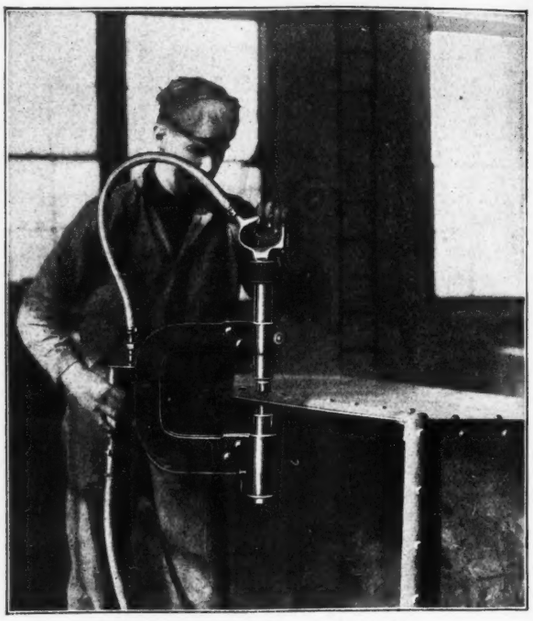


Fig. 13. Hand Yoke Pneumatic Riveter.

holding the anvil of the frame up against the work from beneath, and which serves also as a cushion to receive the impact of the blows. The hammer is adjustable in the frame to accommodate its stroke to various thicknesses of metal. This frame is not limited to the No. 1 size of hammer, but may be used with various sizes of them.

They have introduced also a similar attachment for their drills in the way of a hand drill yoke for use with their "Little Giant" four cylinder piston air drills. A view of this

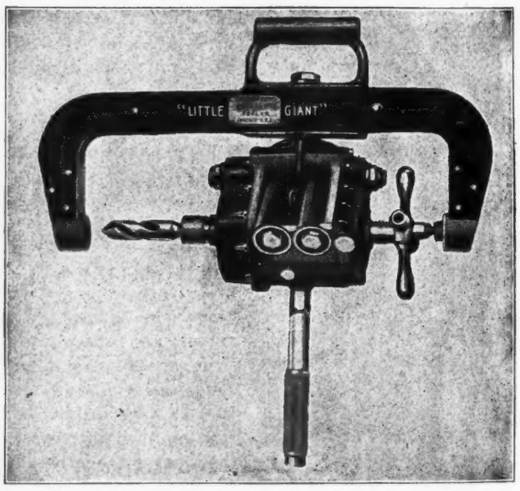


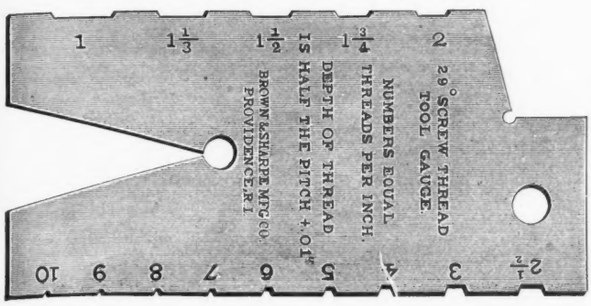
Fig. 14. Pneumatic Driller Yoke.

combination is given in Fig. 14, in which the yoke is shown applied to a No. 2 drill. The yoke is applied by means of a handle which is fastened to the drill, having a slot in one side in which the yoke rests and slides when necessary for adjustment to the size of the piece to be drilled. It is also applicable to various other sizes of the piston drills. This device is particularly convenient for drilling holes in flanges and materials of limited thicknesses.

Brown & Sharpe Manufacturing Company,

Providence, Rhode Island, U. S. A.

SOME NEW TOOLS.



Improved 29° Screw Thread Tool Gauge, "Acme Standard."

This Gauge is new in design and furnishes a correct standard to which tools can be ground to cut threads, of a uniform angle, to take the place of square threads.

The thread has the same depth as the square threads; but, as the sides are at an inclination of 14 1-2° (29° included angle) this form of thread is stronger, and is now generally adopted in cutting worms.

This Gauge is made of the best steel, tempered, adjusted, and all angles accurately tested after hardening.

Washburn & Moen Standard Wire Gauge.

This Gauge is 3 1-4 in. in diameter, and about 1-8 in. thick. It is made from the best steel, tempered, adjusted, and all sizes tested after hardening.

The Gauge numbers, which run from 0 to 36, are those of the Washburn & Moen Standard Wire Gauge.

6 inch Rule with Slide.

This Rule is convenient for measuring against a shoulder, the width of flanges, collars, etc.

The slide is formed to fit the thumb and has a tongue that slides in a groove on the side of the rule. It can be reversed to read either edge of the rule, or it can be removed and the rule used separately.

These Rules are 6 in. long, about 9-16 in. wide, 1-16 in. thick.

Hardware and Supply Dealers carry them in stock. Catalog No. 101, and Descriptive Circulars mailed upon application.

WATER TWIST-DRILL GRINDER.

L. S. Heald & Son, Barre, Mass., are now building certain styles of their "American" twist-drill grinder with a water attachment for flushing the drill while being ground. Fig. 15 gives a general view of style W. T. A. of the drill so arranged. Not only the matter of supplying sufficient quantities of water, but also that of properly taking care of it after it has been put on the wheel, has been carefully worked out in this machine by the provision of a system of hoods, shield and drain-pan below. Water is supplied to the jet at the wheel by a simple centrifugal pump, which is mounted vertically with the bearings entirely above water, so that their lubrication is not interfered with. This arrangement keeps the pump always primed and also avoids the use of stuffing boxes. The emery wheel is completely encased by a close fitting guard to catch any water adhering to the wheel, and a shield and pan return the water from the wheel to the reservoir beneath. The reservoir consists of two compartments, one of which is used as a settling basin from which the water is strained into the pump suction chamber. A particular advantage of this machine is that the water is applied to the wheel just where it is needed, and does not have a chance to fly off by centrifugal force before reaching the drill point. The company have an exhibit at the Pan-American Exposition showing this machine as well as their standard types of grinders and other tools.

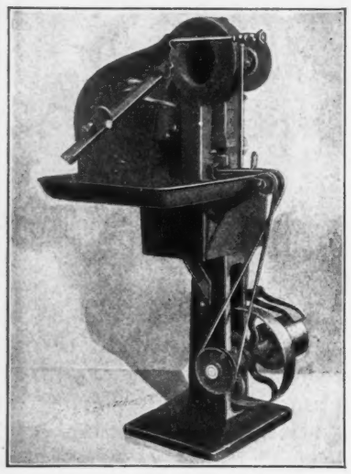


Fig. 15. Water Twist Drill Grinder.

NIPPLE AND PIPE MACHINE.

A pipe threading machine of novel design and with special automatic features has been placed upon the market by the Merrell Mfg. Co., Toledo, Ohio. This machine, shown in Fig. 16, is known as the "Apex" nipple and pipe mill machine, and is on exhibition at the Pan-American Exposition. The head has an adjustable quick opening and closing die which is actuated by a cam movement and it is so swiveled that it can be reversed and the pipe cut off close to the grippers. The vise may be opened and closed while the machine is in motion by simply moving a dog either forward or backward, and the sleeve operating the vise is adjustable to compensate for wear. The nipple grips have the special advantage of being able to be closed upon the threaded end of a pipe without injury to the thread in the least, so that a nipple may be completely threaded. The machine has a reamer to ream out the burr left by the cutting-off tool, and also the threading device is furnished with a threading gage which automatically releases the chasers when the desired length of thread has been cut. It will cut left-hand threads as well as right-hand, and the chasers, five in number, may be set by graduation to any size desired and may be sharpened easily by grinding. The gearing is entirely protected from dust, being inside the cone pulley, and the oil pump, which is beneath the bed out of the way, floods either the dies or the cutting off knife as desired. The machine is made in two sizes, the No. 1 having a range from ¼-inch to 2-inch pipe and the No. 2 from 1-inch to 4 inch pipe.

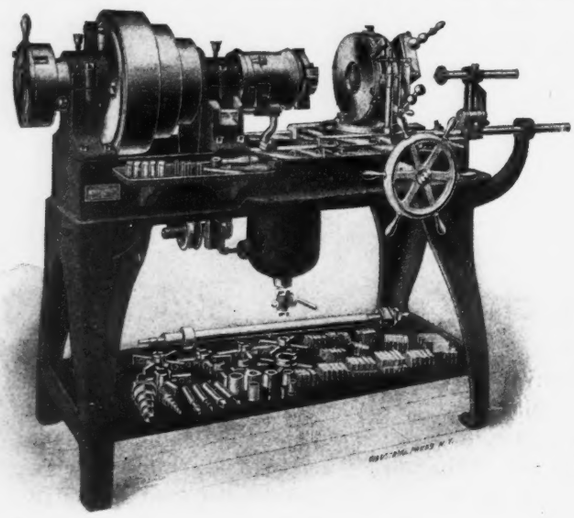


Fig. 16. Pipe Machine.

* * *

THE TAPER GAGE IS PATENTED.

We are informed that the taper gage described by W. W. Cowles, Waterbury, Conn., in the June issue, was patented in 1896 by Orrin Forbush of the Millers Falls Company, Millers Falls, Mass. The number of the patent covering the essential feature of this gage—the V-shaped blade and V-groove—is 573,457. It has never been manufactured for sale, which appears unfortunate, as undoubtedly there would be some call for it if on the market.

* * *

September 13, 1901, has been designated as Railroad Day at the Pan-American Exposition and the arrangements for the occasion have been entrusted to the Central Railway Club. The co-operation of the other railway clubs will be sought and every effort made to have the occasion a complete success. It is desired to secure an attendance on that day which will make a record in the history of the Exposition.

* * *

FRESH FROM THE PRESS.

EASY LESSONS IN MECHANICAL DRAWING AND MACHINE DESIGN. By J. G. A. Meyer and Charles G. Peker. Parts 15 and 16. Fully illustrated. Published by the Industrial Publication Company, 16 Thomas Street, New York. Price 50 cents per part.

Many readers of MACHINERY will be pleased to know that the above series is to be completed. The death of Mr. Meyer caused a cessation of publishing the parts, of which fourteen had been issued up to that time. Mr. Meyer left the manuscripts and drawings for the remaining parts, of which twenty-four were originally projected. These are being arranged and edited by Charles G. Peker, who was Mr. Meyer's assistant, and who thus is familiar with the scope of the complete work. It has been found, however, that it will not be necessary to issue twenty-four parts, as originally planned, but that twenty parts will cover the ground. In view of the praise we have hitherto bestowed on this work, it seems scarcely necessary to again call attention to its general excellence, except it may be for those unfamiliar with it. The author was one of the most painstaking men, and had had a wide and varied mechanical experience. He was the author of "Modern Locomotive Construction," a work of considerable reputation. In the preparation of the present series no effort was spared to make it comprehensive, yet so simple as to make it readily understood and appreciated by the man of limited education. Part 15 was issued May 1, and Part 16 July 1, 1901. The others will follow at intervals of about two months. The parts will be supplied through the regular agents or from the office of publication as noted above.

ADVERTISING LITERATURE.

We have received the following catalogues and trade circulars:

E. G. SMITH, Columbia Pa. Catalogue of Columbia vernier calipers, spherometers, micrometer calipers and steel rules.

THE STANDARD TOOL CO., Cleveland, O. Illustrated catalogue of twist drills, reamers, chucks, twist drill and steel wire gages, milling cutters, taps and dies, twist drill grinders, etc.

GAY & WARD, Athol, Mass. Catalogue of milling cutters for all purposes, metal slitting saws, angular cutters, end mills, screw slotting cutters, etc.

THE CINCINNATI MILLING MACHINE CO., Cincinnati, O. Illustrated catalogue of new pattern milling machines, of their Nos. 3 and 4 plain, and Nos. 1½, 2 and 3 universal types.

THE B. F. STURTEVANT CO., Boston, Mass. Illustrated catalogue of disk and propeller fans with direct-connected engines, direct-connected electric motors, or for belt connection.

THE GARVIN MACHINE CO., New York City. An illustrated catalogue of Nos. 1 to 4 of their universal milling machines, showing important details of their construction.

THE CHISHOLM & MOORE MFG. CO., Cleveland O. Appendix C to their 1900 catalogue, in which reference is made to their anti-friction chain hoists, pneumatic trolleys and hoists and pneumatic traveling cranes, and also to their pneumatic motors and drills.

THE CARBORUNDUM CO., Niagara Falls, N. Y. A very artistic catalogue descriptive of the discovery and rapid development of the carborundum industry, and illustrative of beauties to be found where carborundum is made.

THE HYDRAULIC PRESS MFG. CO., Mt. Gilead, O. Illustrated catalogue of hydraulic presses for all purposes, such as stamping, vulcanizing, molding, veneering, etc., filter presses, accumulators, and hydraulic pressure pumps.

THE E. F. REECE CO., Greenfield, Mass. Catalogue of the Reece hand screw plate, interchangeable tap and die holders, and taps and dies of all kinds and sizes. The Reece patent screw plate has an adjustable guide arrangement to hold the stock perfectly straight, and the Reece dies are of the round pattern and adjustable so as to allow of nuts and bolts being made to fit loosely or tightly as desired.

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DOMESTIC EDITION.—ADVERTISING INDEX PAGES 27-29.

MACHINERY.

VOL. 7. AUGUST, 1901. No. 12.

PUBLICATION OFFICE 9-15 MURRAY STREET NEW YORK

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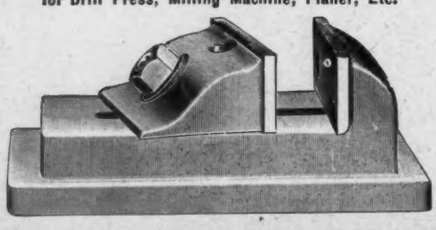

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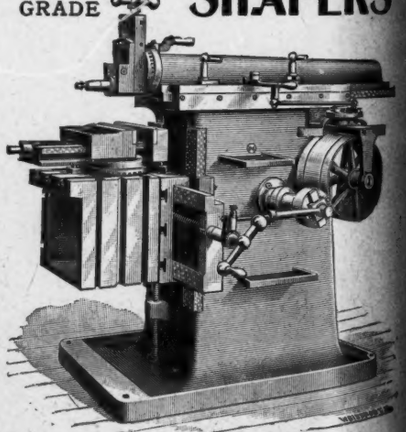

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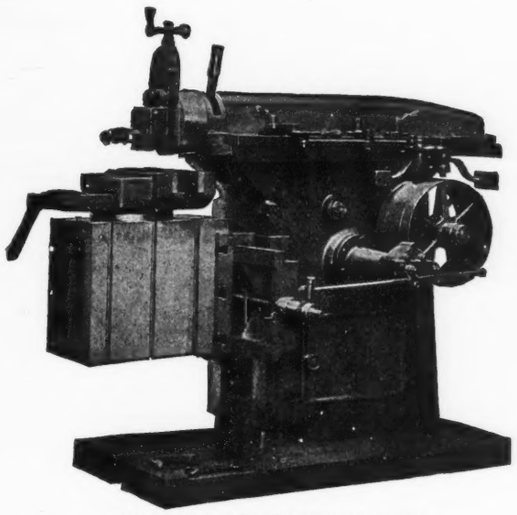

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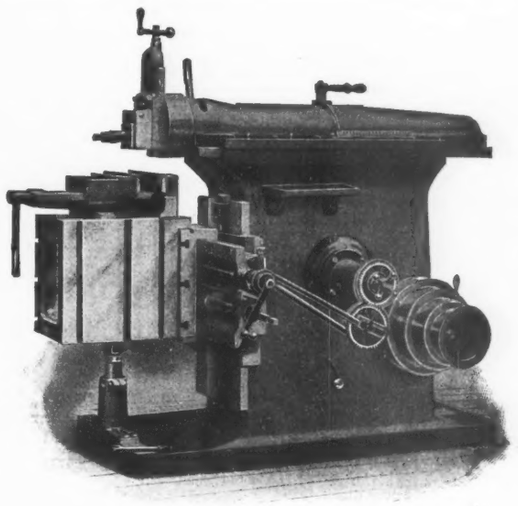

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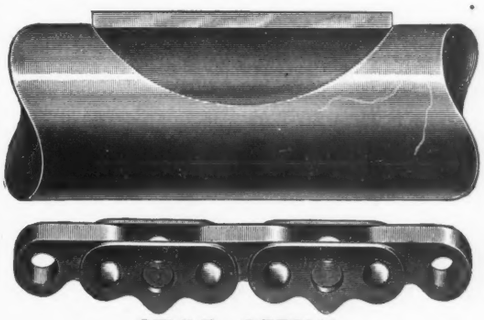

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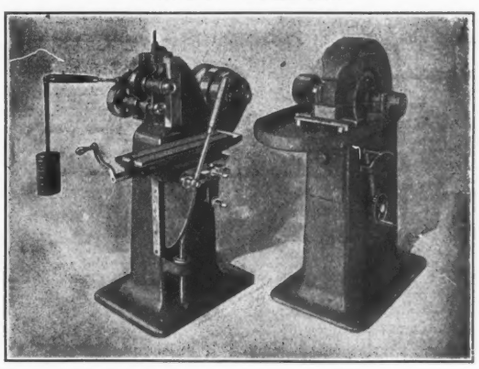

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For Sale advertisements under this heading 25 cents a line, 8 words to a line; $2.50 an inch, 12 lines to an inch, each insertion. Wanted advertisements, 10 cents a line each insertion. Copy must be received not later than the 24th of each month for the issue following.

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18 in. chucking machine.
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All our line.
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11 x 12 ideal engine.

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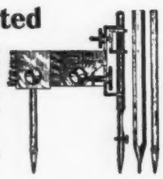

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84 in. Bement.
11 ft. Pitt lathe.
54 in. x 24 ft. Pond.

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Niles flat turret lathe.
Automatic screw machine, Pratt & Whitney.
No. 2½ screw machine, Pratt & Whitney.
No. 4 screw machine, Brown & Sharpe.
Chucking lathe, Pratt & Whitney.

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36 in. x 36 in. x 11 ft. D. L. Harris.

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25 in. pillar friction shaper, Hendey.

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Hand milling machine, Ames Mfg. Co.
Large plain B. G. milling machine, Brown & Sharpe.

DRILLS.

No. 2 three-spindle gang drill, Garvin.
Three-spindle drill, Hendey.
5 in. arm radial drill, Niles.

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Hor. bor. machine, Nicholson & Waterman.
28 in. x 12 ft. hor. bor. and drill. machine, Sellers.
18 ft. x 6 in. bor. and facing machine, Bement.
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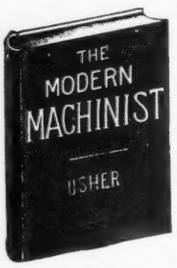

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46-64 x 30 double-end lathe.
49 x 14 Fitchburg lathe, C. R.
36 x 23 engine lathe.
36 x 18 Betts engine lathe, C. R.
32 x 10 Draper, C. R. & P. C. F.
30 x 23 D. W. Pond, C. R. & P. C. F.
27 x 12 Draper, C. R. & P. C. F.
26 x 12 Wright, C. R. & chuck.
26 x 10 New Haven, C. R.
24 x 10 Draper lathe.
20 x 8 Putnam, R. & F. & P. C. F.
20 x 7 Draper, C. R. & P. C. F.
18 x 8 Draper, C. R. & P. C. F.
15 x 8 Draper, C. R. & taper.
15 x 6 Reed, P. G.
15 x 6 Prentice Bros.
Three Bement axle lathes.
61 x 64 x 23 Hepworth planer.
26 x 26 x 6 Putnam planer.
24 x 24 x 8 Pratt & Whitney planer.
24 x 24 x 6 Flather planer.
24 x 24 x 5 ft. 6 Whitcomb planer.
18 x 16 x 3 ft. 6 Putnam planer.
16 x 12 crank planer.
20 ft. hydraulic keel-bending machine.
8 ft. 6 power bending rolls.
19 ft. 6 Swamscot plate planer.
1,700 lb. Merrill drop hammer.
1,400 lb. Merrill drop hammer.
No. 2 and No. 3 Landis grinders.
No. 2 Brown & Sharpe surface grinder.
No. 3 Brown & Sharpe cutter grinder.
No. 1 Brown & Sharpe universal miller.
27 x 18 ft. Springfield surface grinder.
Double-end punch and shear, capacity, 1½ in. x 1 in.
60 in. Pond vertical boring and turning mill.
50 in. Bickford vertical boring and turning mill.
56 x 12 Nicholson & Waterman horizontal boring and drilling machine.

Also large assortment of shapers, milling machines, upright drills and sensitive drills, etc. Send for second-hand list.

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Boston Office, 200 Franklin Street.

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Steam Engineering.

Thoroughly covers the field of Steam Engineering and is a practical paper for Steam Engineers and power users. 32 pages of reading matter, the best value for the money of any paper of its class.

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U. S. A.

CONTENTS FOR AUGUST.

BROWN & SHARPE MFG. CO., Providence, R. I. A Pan-American catalogue entitled "Here and There in Our Shops," embracing a brief historical note and illustrating several distinctive features of their large works.

STANDARD PNEUMATIC TOOL CO., Chicago, Ill. Catalogue F, containing lists of sizes and views of their piston air drills, pneumatic hammers and other pneumatic appliances, showing views of them in practical use.

JAS. L. ROBERTSON & SONS, New York City. Illustrated catalogue of steam specialties, including the Hine eliminator, Robertson feed water heater, pressure regulators, steam traps, exhaust heads, grates and supplies, with especial reference to the Robertson-Thompson steam engine indicator and Willis planimeter.

WM. SELLERS & CO., Philadelphia, Pa. Illustrated catalogue of shafting and power transmission appliances, such as pulleys, hangers, clutches, couplings, belt-tighteners, etc., and a general catalogue of their metal-working machine tools, as bolt and nut machines, boring mills, drilling machines, steam hammers, heavy lathes and planers, punches, shears, riveters, plate rolls and shaping machines, cranes of all kinds, etc.

MANUFACTURERS' NOTES.

THE CLEVELAND TWIST DRILL CO., through their New York agent, Mr. C. I. Markham, inform us that the new address of their New York office is 62 Reade St., near Broadway.

J. W. KERSHAW, University College, Sheffield, England, would like to receive catalogues and photographs of American machine tools for use in his technical school.

THE BURT MFG. CO., Akron, O., have recently installed several Cross oil filters in the New York City public school buildings. Their field is large. They show a saving wherever oil is used for lubrication.

THE PRENTISS TOOL & SUPPLY CO., New York, wish us to state that in their advertisement in the July issue of this paper the Acme Machine Screw Co., Hartford, Conn., were inadvertently omitted from the list of manufacturers for whom they are selling agents.

THE INTERNATIONAL CORRESPONDENCE SCHOOLS, Scranton, Pa., inform us that among the prominent visitors at the schools recently were Edwin J. Houston, of the Thomson-Houston Electric Co., and others, who expressed themselves as very favorably impressed with the schools' system of instruction by mail.

THE BROWN & SHARPE MFG. CO., Providence, R. I., announce that from August 3 to 17, inclusive, their works will be closed for the annual vacation and repairs. During this time the office will be kept open as usual, and orders for machine tools, machinists' tools and measuring tools listed in their catalogue will receive the same attention as at other periods of the year.

BINSSE & HAUSCHILD, doing business as the Newark Machine Tool Works, have decided to incorporate their business for the purpose of preserving it in case of death of either of its owners. They have transferred to the Binsse Machine Co. all the assets and liabilities of their former partnership, and will continue their business as before, with no other change.

THE ARGUTO OILLESS BEARING CO., Wayne Junction, Philadelphia, Pa., are reporting increased activity with their Arguto bearings. The Arguto bearing is made of chemically treated wood which requires no oil, graphite, or other substance for lubricant, thus making it especially adaptable to positions requiring cleanliness, as well as to bearings in inaccessible places where oiling would be impossible.

In the last number of the paper a letter by Mr. J. R. Gordon described an electrically driven center grinder, and his communication has been read by James Clark, Jr., & Co., Louisville, Ky., who state that they manufacture an electrically driven grinder for use on lathe centers. The machine is self-contained and can be connected to any convenient incandescent lamp socket. They will be pleased to furnish description to any one interested.

THE NEW PROCESS RAW HIDE CO., Syracuse, N. Y., have recently shipped a New Process noiseless pinion and cut cast iron mate to Glasgow, Scotland, to be used in connecting an electric motor to a Babcock printing press in use at the Glasgow Exhibition.

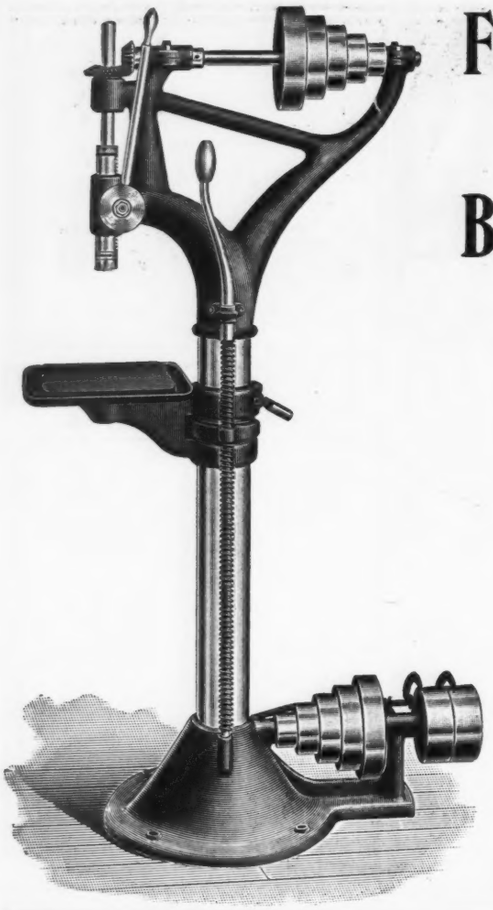
THE CLEVELAND PNEUMATIC TOOL CO., Cleveland, O., have opened a New York office at 15 Cortlandt St., in charge of W. F. McGuire, where samples of their complete line of chipping, beading and calking hammers; the Cleveland Long Stroke riveting hammers; piston, rotary and breast drills can be seen.

MR. CECIL B. SMITH, assistant engineer, City Engineer's Department, Toronto, Canada, and Mr. William S. Aldrich, professor of Electrical Engineering, University of Illinois, have opened an office as consulting engineers in Rooms 101-103, Mail and Empire Building, Toronto, Canada.

The Standard Pneumatic Tool Co., Chicago, Ill., advise us that Mr. Jas. H. Manning, formerly master mechanic of the Union Pacific R. R. Co., Cheyenne, Wyo., has been appointed their western manager, with offices at San Francisco, Cal. A complete line of their "Little Giant" pneumatic tools and appliances will be carried in stock, in order to supply promptly the increasing demand for these machines upon the Pacific Coast.

THE B. F. STURTEVANT CO., Hyde Park, Mass., have sketch plans for their new plant now well under way. This plant will probably provide about eight acres of floor space—fully double that existing in the old plant at Jamaica Plain. Nearly one-third of this area will be devoted to the manufacture of engines, motors and generating sets. They say that the recent growth of this department has been almost phenomenal, and that it is in this field, particularly in the application of Sturtevant motors to Sturtevant fans, that the most rapid growth is expected in the immediate future. The entire plant will be equipped with Sturtevant generating sets and motors for direct driving of line shafts and of large individual machines.

THE NEW PROCESS RAW HIDE CO., Syracuse, N. Y., have sent us a copy of a letter written them by the Goss Printing Press Co., Chicago, Ill., which is a very strong testimonial to the merits of the New Process raw hide pinions. The daily Paris edition of the New York Times was printed on Goss newspaper perfecting presses. On these presses were used raw hide pinions made by the New Process Raw Hide Co. An accident occurred during the printing one afternoon by which a cast iron gear was broken and the teeth were embedded in the pinions. After the broken teeth were removed and a new gear substituted the raw hide pinions were found to be comparatively uninjured, and were used to operate the press until the end of the Exposition, and were still good for considerable more service.



FOR LIGHT AND MEDIUM WORK

THIS NEW 14 INCH

B. F. BARNES UPRIGHT DRILL

is, we believe, the best tool on the market. It is a substantial, well built machine, the driving power is strong and positive, the five step cone gives wide range of speeds, and we guarantee it to drill from 1-16 inch to 3-4 inch. It will do a whole lot of work for a machine of its size and do it right too.

Details are yours for the asking.

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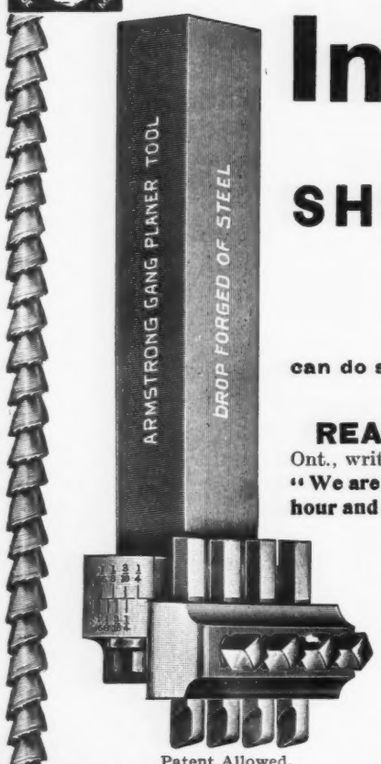
ROCKFORD, ILLINOIS.

AGENCIES—Prentiss Tool & Supply Co., New York, Pittsburg and Boston. Pratt & Whitney Co., Chicago. The Charles A. Strelinger Co., Detroit. The Strong, Carlisle & Hammond Co., Cleveland. J. W. Wright & Co., St. Louis, Mo. Henry W. Peabody & Co., France and Germany. J. F. Villalta, Barcelona, Spain (Spain and Portugal.)



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Improved Tools

are the strongest factors making for a

SHORTER WORKING DAY.

THE MAN who objects to using an ARMSTRONG GANG PLANER TOOL

can do so only because it **MAKES LONG JOBS SHORT** and he casts his vote for a Longer Working Day.

READ THIS: Mr. Wm. Watson, Sup't of The Northey Company, Ltd., of Toronto, Ont., writes us the following concerning his experience with the Armstrong Planer Tool: **"We are planing the bases of our gas engine beds in 23 minutes that formerly took 1 hour and 28 minutes before we got this tool."**

INVESTIGATE! **WRITE FOR CATALOG.**

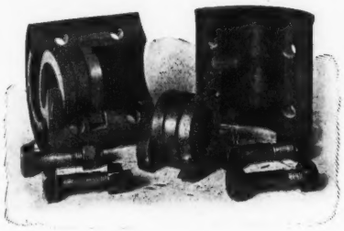
ARMSTRONG BROS. TOOL CO., Chicago.

"The Tool Holder People."

See our Pan-American Exhibit, Block 38, Machinery Building.

FOREIGN AGENTS: Chas. Churchill & Co., Ltd., London, Manchester, Birmingham, Glasgow. Schuchardt & Schutte, Berlin, Brussels, Vienna, Stockholm. Markt & Co., Ltd., Paris. G. Koeppen & Co, Moscow. Aikenhead Hardware Co., Toronto. A. R Williams & Co., Montreal.

"The harder the pull, the tighter the grip."



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A simple, practical, permanent coupling at last—
No keys, or keyseating—
No stripping of the shaft—
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Anyone can put it on — and when once on it is there to stay—
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You simply can't break the grip.

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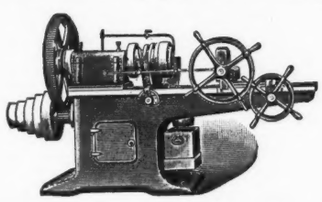
The Morgan Bolt Cutters

are unequaled for productive capacity and durability. They combine the lightest action with the greatest possible efficiency and economy. It will pay you to investigate.



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Eureka Rust Preventive makes machines sightly and the polished parts brighter. Holds firm, and easy to clean. Write for particulars.

METAL POLISH

that works quick and keeps its lustre. Holds old trade and makes new. Does not deteriorate. Established 16 years.

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Expert Polish Maker,
Indianapolis, Indiana.

IMPERIAL TYPE 10

DUPLEX COMPOUND

AIR COMPRESSOR

Like our IMPERIAL TYPE 11 this is an entirely NEW design, not an old machine remodeled. Contains many good features.

WE SHOULD LIKE TO TELL YOU MORE ABOUT IT

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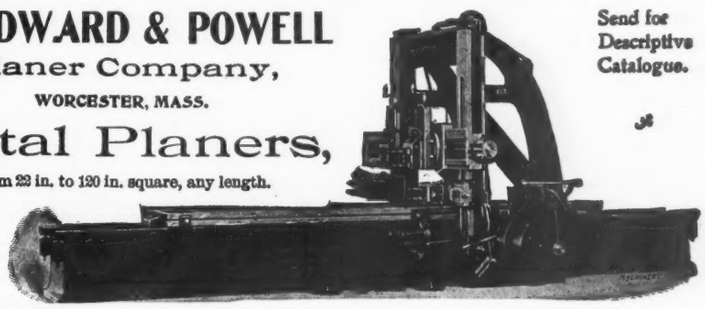
WOODWARD & POWELL
Planer Company,
WORCESTER, MASS.

Metal Planers,

From 22 in. to 120 in. square, any length.

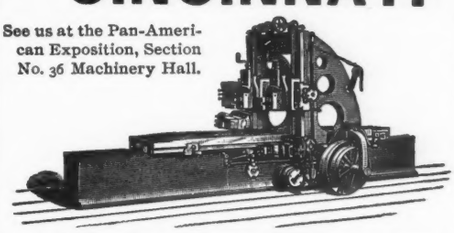


Send for Descriptive Catalogue.

AGENTS: Manning, Maxwell & Moore, New York and Chicago; U. Baird Machinery Co., Pittsburg, Pa.

CINCINNATI PLANERS

See us at the Pan-American Exposition, Section No. 36 Machinery Hall.



Have a Patent Dirt Proof Table which prevents chips from falling into the Vs. They have a Safety Locking Device which avoids accidents and spoiling of work. They have Micrometer Adjustment to the down feed, and a Patent Combination Friction that will not stick or burn out. Made in ten sizes, 24 in. to 56 in. square.

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FOR MILLING MACHINES OR FOR ALL AROUND JOBBING WORK IN THE MACHINE SHOP

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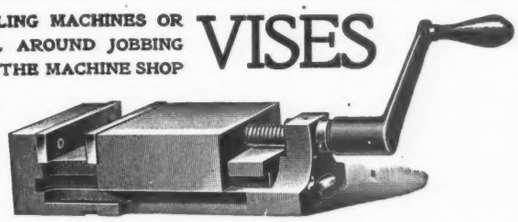
We have three sizes of these Vises in stock and can make prompt shipment. They are first-class in every particular. Send for circulars.



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HARVEY HUBBELL,
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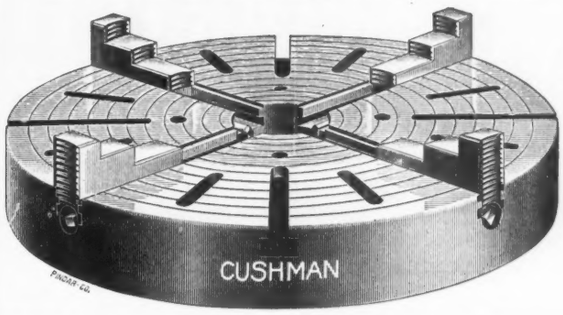
All Sizes and Styles of **CHUCKS.**

"CUSHMAN" CHUCKS



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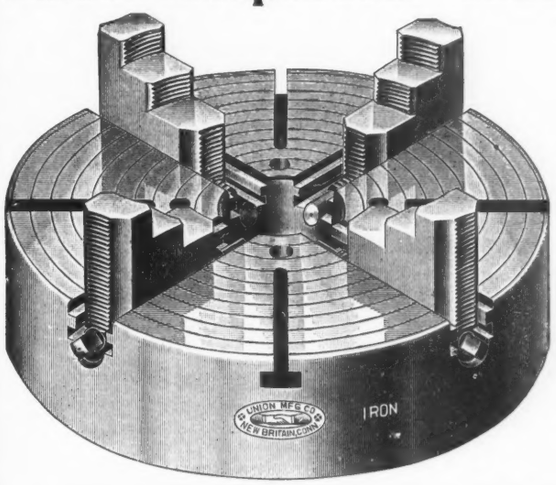

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Union Manufacturing Company,

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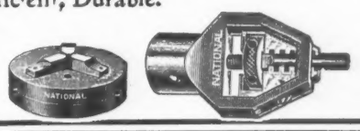
Write for prices and complete illustrated catalogue.



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Manufacturers of the "National" complete line of Chucks.

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Strongest Grip, Greatest Capacity and Durability, Cheap and Accurate.

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Almond Drill Chuck.

Sold at all machinists' supply stores.

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No Weak Places

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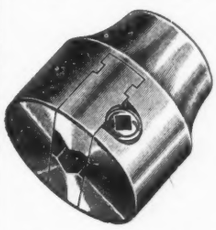

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One part is as strong as another. Outwears any other kind of chuck. Made right and sold at the right price. Circulars and price lists mailed on request.

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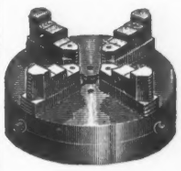
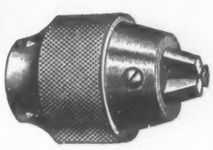
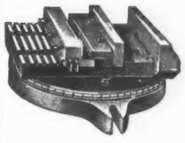


FOR LATHES,



DRILLS



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keep accurate record of amount of work performed by your automatic machinery. **Corrects and prevents mistakes.** Highest awards at World's Fairs.

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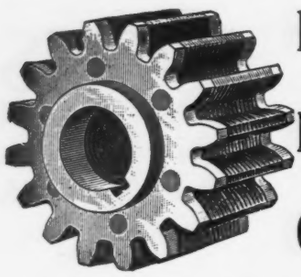

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HORSBURGH & SCOTT, Mfrs.,
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Hindley Worm Gearing

Saves Power.

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MORSE, WILLIAMS & CO.
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CUT BY MACHINERY.

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Helical Gears, single or double. Any angle or ratio to 6 feet in dia. Worms & Worm Wheels and Bevels to 6 feet and Spur Gears to 7 feet in dia.

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UP TO TEN FEET DIAMETER
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COST REDUCING SPECIAL MACHINERY

Designed and Built to Order.

DRILLING, MILLING AND BORING TOOLS.

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OUR SPECIALTY IS
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Write for our catalog containing full information about our

NEW PROCESS PINIONS

The only Noiseless Pinions which are **Durable**

WE ALSO MAKE METAL GEARS.

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PINIONS

STYLE A IN USE.

J. R. DUFF'S HAND DRILLER

For Bit Braces. Chain Attachments and Screw Feed.

This time and labor saving Tool can be quickly applied, works easily and drills metals to 1 inch hole.

Well finished, strongly made and moderate in price. Three styles, A, AA and B. Send for prices and full description.

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PRESSED STEEL **Shop Pans or Tote Boxes**

For Machine Shops and Foundries, Bolt Works, Etc.

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THIS CUT REPRESENTS SIZE "G."

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Suitable for handling bolts, rivets, nails, screws, nuts, washers, castings, ore, quartz, and other substances, and for use under lathes and drill presses to catch the turnings, trimmings, borings, oil drippings, etc.
Send for Catalogue.

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THOS. L. DICKINSON, 45 Vesey Street, New York City.

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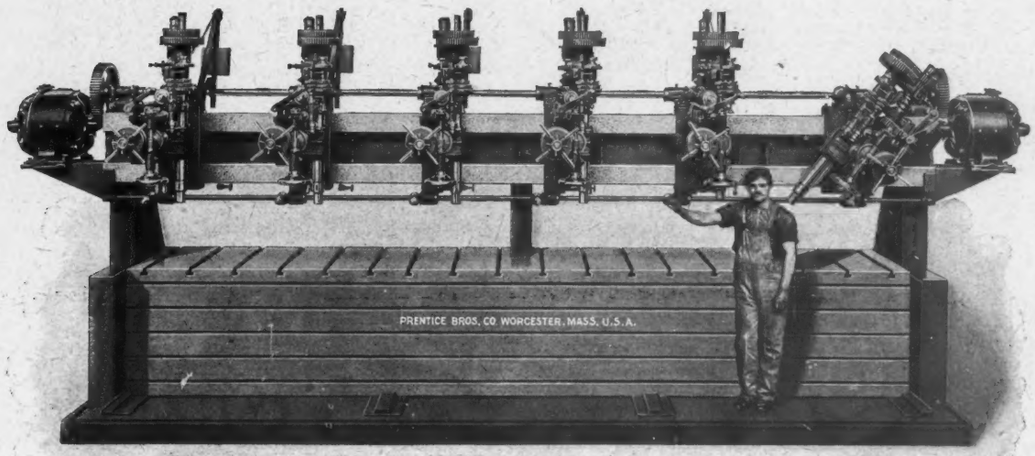
WORCESTER, MASS., U. S A.



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BUILDERS OF

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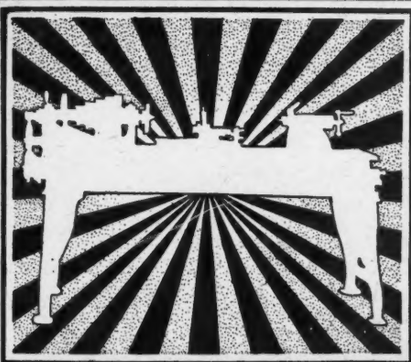

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14 in. to 42 in. Swing.
ALL POSSIBLE COMBINATIONS.
CRANK SHAPERS
12 in., 15 in. and 20 in. Stroke.
WE INVITE CORRESPONDENCE

THE SPRINGFIELD MACHINE TOOL CO.
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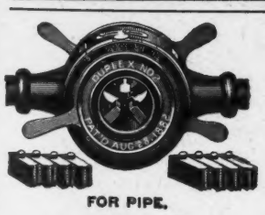
PUNCHES FOR BOILERS, BRIDGES, SHIPS and all work where rivets are used.

I can save you time and money.
Send for large Sheet about Punches.



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Are urged to look into the merits of our celebrated

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FOR BOLTS.

They have no Equals.

Send Postal Request for List.

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WORTH ITS WEIGHT IN GOLD TO USERS OF POWER & LIGHT.
SUBSCRIBE FOR IT!
QUARTERLY, - - $1 A YEAR.
TROY, N. Y.

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Of Every Description.

BUTTERFIELD & CO.,
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CUTTING-OFF MACHINES.

A new line of Accelerated Speed 2 to 9 Inches.

THE HURLBUT & ROGERS CO.
SOUTH SUDBURY, MASS.
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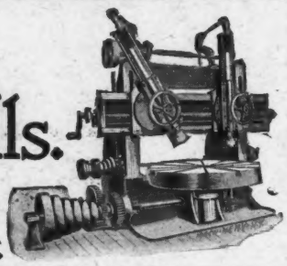

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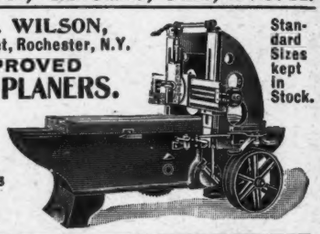

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